INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/2004/06–5–898–900
http://www.ijab.org

Radio Sensitivity of Various Wheat Genotypes in M_1 Generation

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ABSTRACT

Significant decrease in germination percentage of all the wheat genotypes was recorded with an increase in the radiation intensity. The lowest germination percentage (14.60) was recorded with 45 Krad dose and the highest germination percentage (74.26) was recorded in control. The difference in the mean value of control and 15 Krad dose of radiation was non-significant, but they differed significantly from 25, 35, and 45 Krad doses of radiation. The average plant height was also significantly decreased with various doses of gamma radiation in all the five genotypes. The maximum reduction (23.63%) in plant height was recorded with 45 Krad as compared to control. Similarly significant reduction in number of tillers plant^{-1} was observed by various radiation doses but remarkable decrease (52.53%) was obtained with 45 Krad dose.

Key Words: Radiation; Genotypes; Wheat; Genetic variation; Gamma rays

INTRODUCTION

History of wheat (*Triticum aestivum* L.*)* improvement by acclimatization, selection and hybridization dates back to the remote past, but with the passage of time these methods were found to be unsatisfactory because of the limited genetic variation among the existing wheat population. The early research work of Muller (1927) and Stadler (1928) however, opened a new era in the field of plant improvement. Therefore, the plant breeders and geneticists of the 20th century were inclined to radiation as a new tool for plant improvement. Nowadays, mutation induction has become an established tool in plant breeding to supplement existing germplasm, and to improve cultivars in certain specific traits. Large number of improved varieties has been released to farmers for different crop species, demonstrating the economic value of the technology.

Mutation breeding have been conducted on most crops species including barley, rice peanut etc. Swedish scientists (Hagberg *et al.*, 1963; Gustafsson *et al.*, 1971) were very vigilant to discover the possible application of radiation for the improvement of crops. In cereals they discovered erectoid mutants in barley. The new variety so released was superior to its mother variety in some characteristics like stiffness of straw, earliness in maturity, high protein contents etc. Mucci (1962) observed variations in height, ear length, tillering, awning, number of spikelets ear^{-1} and time of maturity of plants due to gamma rays in wheat. Khan and Bari (1971) studied the effect of mutation on wheat. Germination and survival was linearly decreasing with increase of radiation dose in case of gamma rays and fast neutron, but not in case of beta rays and chemical mutagens. Millado *et al.* (1972) studied the effect of various doses of gamma radiation on plant height, number of tiller plant^{-1}, grain weight plant^{-1} in wheat and concluded that in general 10 KR and 15 KR increased the mean value of each trait studied. On the other hand higher doses tended to reduce them. Ghafoor and Siddiqui (1976) studied the effects of gamma rays and fast neutron on tillers number and plant height in six cultivars of wheat. The results showed that these cultivars differed significantly for both the characters. Choudhry (1983) exposed dry grains of six well adapted cultivars to 10-14 kr gamma rays and evaluated for germination and survival. Results suggested that the lower dose may increase germination particularly in lines with poor germination. Hassan (1986) observed that 40 Krad dose caused maximum reduction in various genetic parameters of wheat and triticale. The present study was designed to create genetic variability in five wheat genotypes and to determine favourable effects of various radiation doses on germination percentage, plant height and number of tillers plant^{-1} in M_1 generation for agro-climatic condition of D.I. Khan region.

MATERIALS AND METHODS

A Field experiment was carried out during 1995-1996 in the experimental fields of Department of Plant Breeding and Genetics, Faculty of Agriculture, Gomal University, Dera Ismail Khan, to study the genetic variation in germination percentage, plant height and number of tillers plant^{-1} in M_1 generation of five wheat genotypes. Pure dry seeds of Pak-81, Pirsabak-85, Khyber-87, Pirsabak-91, and Inqilab-91 were got irradiated with gamma rays from Co^{60} gamma source at the Nuclear Institute for Food and Agriculture (NIFA), Tarnab, Peshawar. The seeds of aforementioned genotypes were subjected to 15, 25, 35, 45 Krad doses of gamma irradiation to study the variation in germination percentage, plant height and number of tillers plant^{-1}. Hence, there were four irradiated seed lots and one control, totaling five treatments for each genotype. The design of the experiment was split-plot with four replications. The experimental plot size was kept at 354.2 m^2. The distance between the two adjacent rows was 30 cm while the plant to plant distance with in the row was 15 cm. The five

Table I. Genotypes X Dose interaction for germination percentage in M_1 generation of Wheat

Radiation doses (KR)	Genotypes					Average
	Pak-81	PS-85	Khy-87	PS-91	Inqilab-91	
00	72.80	75.00	76.00	73.50	74.00	74.26 A
15	71.00	72.25	74.25	72.50	72.50	72.50 A
25	56.50	57.45	57.00	57.25	57.15	57.07 B
35	37.50	36.25	36.75	37.25	36.50	36.85 C
45	14.00	14.75	14.75	14.50	15.00	14.60 D
Mean	50.36	51.14	51.75	51.00	51.03	

Table II. Genotypes X Dose interaction for plant height (cm) in M_1 generation of Wheat

Radiation doses (KR)	Genotypes					Average
	Pak-81	PS-85	Khy-87	PS-91	Inqilab-91	
00	108.50	102.75	102.75	103.0	102.50	103.80A
15	100.00	99.50	99.75	100.25	100.10	99.82 B
25	92.50	91.50	92.00	91.00	91.75	91.75 C
35	85.50	84.50	82.50	85.75	84.75	84.60 D
45	80.75	79.75	75.75	81.50	79.00	75.35 E
Mean	93.35A	91.60B	90.55B	92.30A	91.62B	

Table III. Genotypes X Dose interaction for number of tillers plant^{-1} in M_1 generation of Wheat.

Radiation doses (KR)	Genotypes					Average
	Pak-81	PS-85	Khy-87	PS-91	Inqilab-91	
00	10.25	10.50	10.75	10.50	11.00	10.60 A
15	9.25	9.50	10.25	9.50	10.00	9.70 B
25	7.25	8.25	8.25	7.50	8.00	7.85 C
35	6.00	6.25	6.25	6.25	6.50	6.25 D
45	4.50	5.00	5.00	5.50	5.25	5.05 E
Mean	7.45	7.90	8.10	7.85	8.15	

varieties were allocated at random to main plots (blocks), while four levels of gamma irradiation plus control were assigned to subplots at random in each block. A basic dose of N.P.K. 55-28-00 kg ha^{-1} was applied according to the recommended procedure. The land for sowing of seeds was ploughed properly. Normal agricultural practices for raising the wheat crop were applied uniformly for all the treatments. The irradiated seeds along with control were sown on November 15, 1995, to get M_1 generation. Maximum 10 plants at random were selected for each subplot for each treatment for observing the effect of radiation on germination percentage, plant height, and number of tiller plant^{-1}.

Germination percentage was calculated by multiplying the number of grains germinated with 100 and was divided by the total number of grain sown. For the plant height, 10 selected plants from each sub-plot measured at maturity in centimeters from the soil surface to the tip of the spike. For the number of tillers plant^{-1}, ten selected plants in each sub-plot were counted by uprooting the plants at the maturity.

Statistical analysis. The data thus collected on germination percentage, plant height, and number of tiller plant^{-1} was subjected to analysis of statistical manipulation as outlined by Steel and Torrie (1980). While the effect of radiation doses and varietal response were compared by Duncan,s new multiple range test.

RESULTS AND DISCUSSION

Germination percentage. According to data (Table I) the differences in the mean values due to 15, 25, 35, and 45 Krad gamma rays doses were highly significant. The data revealed that the range of mean values for radiation doses was 14.60 to 74.26 for germination percentage. The lowest germination percentage (14.6) was recorded with 45 Krad dose and the highest germination of 74.26 was recorded in control. Generally a significant decrease was observed with an increase in the radiation intensity and the decrease was inversely related to the intensity of gamma rays doses. The differences in the mean value of control and 15 Krad dose of radiation were non-significant, but they differed significantly from 25, 35 and 45 Krad doses of radiation. The differences recorded in mean values due to genotypes for germination percentage were non-significant and the values were in the range of 50.36 for Pak-81, 51.14 for Pirsabak-85, 51.75 for Khyber-87, 51.00 for Pirsabak-91, and 51.03 for Inqilab-91.

Effect of interaction between doses of gamma rays and genotypes was non-significant. The values recorded for interaction ranged from 14.00 to 72.80, 14.75 to 75.00, 14.75 to 76.00, 14.50 to 73.50, 15.00 to 74.00 for Pak-81, Pirsabak-85, Khyber-87, Pirsabak-91, and Inqilab-91 respectively. The decrease in the mean value due to 45 Krad dose was computed as 80.77, 80.33, 80.59, 80.27 and 79.72% for Pak-81, Pirsabak-85, Khyber-87, Pirsabak-91, and Inqilab-91 respectively as compared with their respective control. These results are in agreement with those of Khan and Bari (1971); Choudhry (1983) and Hassan (1986) who also recorded variations in different parameters of the crop.

Plant height (cm). The difference found in the mean values due to genotypes for plant height in Pak-81, Pirsabak-85, Khyber-87, Pirsabak-91 and Inqilab-91 were highly significant and the values recorded were 93.35, 91.60, 90.55, 92.30 and 91.62 cm for Pak-81, Pirsabak-85, Khyber-87, Pirsabak-91, and Inqilab-91 respectively (Table II). It is evident from the data (Table II) that Pak-81 and Pirsabak-91 were statistically at per with each other but differed from Pirsabak-85, Khyber-87 and Inqilab-91 which had a shorter plant height than Pak-81 and Pirsabak-91. The effects of various doses were highly significant. By comparing the mean values of various gamma rays with each other, it was noted that on the average plant height decreased with increase in radiation doses. The mean values for plant height in different radiation doses for Pak-81, Pirsabak-85, Khyber-87, Pirsabak-91, and Inqilab-91 ranged

between 75.35 to 103.80 cm. The maximum decrease of 23.63% in plant height was obtained in response to 45 Krad dose as compared to the mean value of control (103.80 cm). The interaction between genotypes and doses was non-significant, yet the data obtained for effects of radiation doses on varieties indicated that the various radiation doses had produced gradual reduction in plant height in Pak-81, Pirsabak-85, Khyber-87, Pirsabak-91 and Inqilab-91. The values obtained were ranging between 80.75 to 108.50, 79.75 to 102.75, 75.75 to 102.75, 81.50 to 103.00, 79.00 to 102.50 cm in Pak-81, Pirsabak-85, Khyber-87, Pirsabak-91 and Inqilab-91, respectively (Table II). The maximum reduction in plant height due to 45 Krad dose in case of Pak-81, Pirsabak-85, Khyber-87, Pirsabak-91 and Inqilab-91 were 25.58, 22.38, 26.28, 20.87 and 22.93%, respectively as compared to their respective control. These results are in quite conformity with those reported by Ghafoor and Siddiqui (1976), Choudhry (1983) and Hassan (1986).

Number of tillers plant^{-1}. The differences in the mean values for number of tillers plant^{-1} in response to different doses of gamma rays were highly significant and the values ranged from 5.05 to 10.60 (Table III). The lower number of 5.05 tillers was obtained with 45 Krad dose while the maximum number of tillers was obtained in control. The maximum decrease (52.35%) was found with 45 Krad dose in comparison to mean values obtained for control. The effects due to genotypes were non-significant and the mean values recorded for Pak-81, Pirsabak-85, Khyber-87, Pirsabak-91 and Inqilab-91 were 7.45, 7.90, 8.10, 7.85 and 8.15 tillers plant^{-1} respectively. The difference in the mean values due to interaction of doses and genotypes was significant. The values ranged between 4.50 to 10.25, 5.00 to 10.50, 5.00 to 10.75, 5.50 to 10.50 and 5.25 to 11.00 for Pak-81, Pirsabak-85, Khyber-87, Pirsabak-91 and Inqilab-91, respectively. The maximum of 56.09, 52.38, 48.83, 47.61 and 52.27% decrease was found in Pak-81, Pirsabak-85, Khyber-87, Pirsabak-91, and Inqilab-91, respectively in response to 45 Krad as compared to their respective controls.

It was also noticed that all the doses had reduced the average number of tillers plant^{-1} in Pak-81, Pirsabak-85, Khyber-87, Pirsabak-91, and Inqilab-91 as compared to their respective control. The result obtained in the present study are in close agreement with those of Macci (1962), Millado *et al.* (1972) and Hassan (1986) who also observed variations in different genetic parameters of the crop.

Any two means sharing same letters are not significantly different according to New Duncan's multiple range test. Capital letters indicate significance at 5% probability level.

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REFERENCES

Choudhry, R.K., 1983. A note effect of gamma irradiation in wheat. *Wheat Information Sci*., 57: 21–3

Ghafoor, A., and K.A. Siddiqui, 1976. Effect of gamma rays and fast neutrons treatments on tillers number and plant height in wheat. *Pakistan J. Bot*., 8: 1–7

Gustafsson, A., A. Hagberg, G. Persson, and K. Wikland, 1971. Induced mutation and barley improvement. *Theo. Appl. Gene*., 41: 239–48

Hagberg, A., G. Persson and A. Wiberg, 1963. Induced mutation in the improvement of self pollinated crops. *In:* E. Akerberg, A., Hagberg, G., Olssong and O. Tedin, (eds.) *Recent Plant Breeding Research*, pp: 1946–61. svalof. Almqvist and Wiksell, Stockholmn

Hassan, S., 1986. Gamma irradiation induced variations in genetic parameters of wheat and triticale. *Sarhad J. Agric*., 2: 173–9

Khan, A.H., and G. Bari, 1971. Mutation Breeding studies in wheat *Pakistan J. Sci*., 23: 236–9

Millado, Z., M.A. Trajilo, and F.R. Mendozoz, 1972. Effect of different doses of gamma rays Co^{60} on four quantitative characters in wheat (*T. aestivum* L.). *Agro. Sci*., 8B: 41–65

Mucci, F., 1962. Notes on seven years of observations of wheat types from induced mutation in c.v. Tavere. *Ann. Pac. Sci. Agri. Protic*, 28: 314–89

Muller, H.J., 1927. Artificial transmutation of the gene. *Science*, 66: 84–7

Stadler, L.J., 1928. Mutations in barley induced by X–rays and radiations. *Science*, 68: 186–7

Steel, R.G.D., and J.H. Torrie, 1980. *Principle and procedures of statistics A Biometrical Approach*. pp: 232–49. McGraw Hill Book Co. Inc. New York.

(Received 05 August 2004; Accepted 23 August 2004)