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Study of Genetic Variation in Yield Components of Wheat Cultivar Bukhtwar–92 as Induced by Gamma Radiation

Madiha Jamil and Umer Q. Khan
Department of Plant Breeding and Genetics, Faculty of Agriculture, Gomal University, D.I.Khan, Pakistan

Abstract: An experiment was conducted to study the induced variation in yield components of wheat cultivar Bakhtawar–92 by gamma radiation during the Rabi season 1997 – 98. Seeds were exposed to 5, 10, 15, 20 and 25 Krad doses of gamma radiation along with an untreated check. The analysis of the data revealed significant differences among the treatments. The most beneficial dose was 20 Krad. The impact of this dose was promising in germination % (96.47), plant height (82.78), number of grains per plant (59.80), and grain yield (3926), while the other doses such as 5, 10, 15 and 25 showed minor fluctuations in their effects.

Key words: Induced mutation, wheat, cultivars

Introduction

Wheat improvement by acclimatization, selection and hybridization dates back to the remote past, but with the passage of time these methods became time consuming and laborious as well as genetic variation among the existing wheat population has fell limited. Hence plant breeders were inclined to adopt the mutation breeding for crop improvement (Elliot, 1958). Now-a-days, mutation induction has become an established tool in plant breeding to supplement existing germ plasm and to improve cultivars in certain specific traits. A large number of improved varieties of different crop species i.e., CM 72 and NIFA 88 (Gram), Niab-78 (Cotton) and others have been developed through gamma rays, demonstrating the economic value of this technology. Thus, mutation breeding is recognized since the beginning of this century as one of the driving force of evolution, besides selection and hybridization (Muller, 1927).

Mutation is often induced through physical mutagens such as X-rays, gamma rays, fast neutrons, thermal neutrons, ultraviolet and beta radiations (Elliot, 1958). All types of radiations (with the exception of ultraviolet rays) ionize atoms in a tissue by detaching electrons from the atoms (Anonymous, 1977). In addition to physical mutagens a large number of chemical mutagens are also used to induce mutations in crop plants. Most of these belong to the special class of alkylating agents and include ethyl methane sulphonate (EMS), diethyl sulphate (DES), ethylene imine (EI), ethyl nitroso urea (ENU) and methyl nitroso urea (MNU) [Siddiqui, 1994]. Seeds are most commonly used for radiation. They offer a number of advantages. They are easy to handle, store and can be maintained for extended period of time in a vacuum almost free of oxygen as well as under high pressure of oxygen or other gases (Siddiqui, 1994).

Gamma radiation can induce useful as well as harmful effects in crop plants so there is a need to predict the most beneficial dose of gamma rays for improvement of specific traits of crop plants. Singh and Chaturvedy (1981) and Khalil *et al.* (1987) reported late flowering mutants in mungbean and soybean respectively. Wazir (1986) in wheat and Had (1990) in chickpea reported early flowering and short statuted mutants. Lapochkina (1998) obtained increased yield in wheat hybrids irradiated with 1.50 krads of gamma rays.

The gamma radiation is an important tool for inducing genetic variability in different economic characters of wheat. The present studies were designed to create genetic variability in the variety Bakhtawar-92 for D.I.Khan to find out the favorable effects of various radiation doses on its yield components.

Materials and Methods

A field experiment was conducted in the experimental area of Department of Plant Breeding and Genetics, Faculty of Agriculture, Gomal University, D.I.Khan. The genetic material was dry seeds of cv. Bakhtawar-92. The effects of different doses of gamma (γ) radiation were studied in M_1 generation in the morphological traits of wheat. Dry seeds of wheat variety Bakhtawar-92 were subjected to gamma radiation at the rate of 5, 10, 15, 20 and 25 krad at Nuclear institute for Food and Agriculture (NIFA), Peshawar, in a Gamma Research Unit of Co^{60}. The experiment was planted on 5 November, 1997 in randomized complete block design.

The total area of field was 17 x 15.5 m^2. Row to row and plant to plant distance of 23 and 15 cm, respectively was kept and the number of rows per treatment were kept three. The comparison was made with the control (no radiation applied). The fertilizer in the form of nitrophose was applied at the rate of 90 kg ha^{-1}, at the time of sowing. The plots were irrigated at suitable intervals in such a manner that the crop did not experience stress. For controlling weeds three hand hoeing were done.

For studying the morphological and agronomic traits 10 plants were randomly selected for recording the data on germination percentage, number of leaves per plant, days taken to heading, plant height (cm), spike length (cm), number of grains per plant, number of grains per spike, 1000-grain weight (g), grain yield (kg ha^{-1}).

Statistical analysis: The data recorded for the above mentioned characters were averaged and subjected to the statistical manipulation as outlined by Steel and Torrie (1980) and subsequently Duncan's Multiple Range Test was used to establish the differences among the different treatment means.

Results and Discussion

Keeping in view the inhibitory and deleterious effects of higher doses of gamma radiation, the wheat variety Bakhtawar was irradiated with lower doses of gamma rays to see the stimulatory effects of lower intensities of radiation on yield components of the said variety.

The difference in the mean values due to radiation doses were highly significant (Table 1). In case of germination percentage, the data shows that 20 krad dose has a stimulatory effect on germination percentage and produced 96.47% germination as compared to control (66.67) while fifteen Krad produced 33.37% germination. Arora *et al.* (1989) also obtained high percent germination at high doses in wheat.

Number of leaves per plant varied significantly when radiated by various doses of gamma rays. This character is adversely affected by each increment in radiation intensity. The highest dose of 25 Krad caused reduction on leaves per plant (5.8) as compared to control (6.14). 15 Krad dose increased leaves number a little bit. Number of days to heading was apparently increased by each increment in radiation intensity when various doses were compared with control. An increase of 105.8 days was recorded by 25 Krad dose as compared to control (98.66). 5 Krad dose has little effect on days number to heading (99.33). It is clear from the

Table 1: Means performance of various characters of wheat variety Bakhtawar as affected by gamma radiation

Source Krad	Germination (%)	Number of Leaves/plant	Days taken to heading	Plant height (cm)	Spike length (cm)	Grains/ plant	Seeds/ spike	1000-grain weight (g)	Grain yield (kg ha^{-1})
0	66.67c	6.14a	098.66e	81.84a	9.86b	57.60a	352.3f	36.29bc	3704b
5	83.33b	5.88bc	099.33de	78.16b	9.70c	57.97a	376.3d	36.97a	2593e
10	43.30e	5.96b	100.00d	79.00b	10.02a	59.20a	371.4e	35.94bc	2593e
15	33.33f	6.10a	101.90c	82.44a	9.93ab	51.53a	381.9c	35.09d	2962c
20	96.47a	5.98b	103.30b	82.78a	9.82bc	59.80a	390.7a	36.36b	3926a
25	56.63d	5.80c	105.80a	81.40a	9.83bc	54.47a	386.2b	35.77c	2815d

Means sharing a letter in common does not differ significantly at $P \geq 0.05$

present study that radiation intensity delays maturity by increasing days to heading. Hassan *et al.* (1998) reported that heading was delayed in wheat plant at high doses of gamma rays (Table 1).

The results regarding plant height indicate highly significant variations among the radiation doses affecting this trait. The radiation doses of 5 and 10 Krad slightly reduced plant height (78.16 and 79.00 cm) while the other doses have no considerable effect on plant height. These results are similar to the results observed by Drozd (1994) and ElRasses (1991). The data regarding spike length showed significant variability for wheat variety due to different radiation doses. A slight increase of 10.02 cm was noted in the plants radiated with 10 Krad. The high doses of 20 and 25 Krads did not affect the character considerably. These findings are in agreement with Khamankar (1991), who reported a negligible effect of radiation on yield components. The data regarding grain no/spike of wheat shows that this character is a stable one and not affected significantly by radiation intensity. However, the highest no of grains were recorded for 20 Krad. Also 15 and 25 Krad doses caused a non-significant increase as compared to control. This view is also being supported by Khamankar (1991) who observed no effect of radiation on yield components. Data showed that upto 20 Krad, the grain number increases with each increment in radiation intensity. It is evident from this study that lower doses up to 20 Krad are favorable for yield components like no of grains per plant. This opinion has got supported from the results of Arora *et al.* (1989) and Drozd (1994) who reported the maximum number of grains at high doses. From the mean values of 1000 grain weight, it is evident that the range is from 35.09 to 36.97 g. The lowest value was noticed for 15 Krad and the highest was noted for 5 Krad, which proves that low level of radiation increases 1000-grain weight while high doses decrease it. These findings are in close conformity with Sabed *et al.* (1989) and Shafi *et al.* (1992) who also found that radiation impaired with wheat emergence and reduced grain yield.

Finally the data observations of grain yield (kg ha^{-1}) shows highly significant differences among different radiation doses. The lower doses of 5 & 10 have a decreasing effect while the higher dose of 20 Krad has an increasing impact on grain yield.

It is concluded from this study that desirable mutation/variability in wheat can be created through gamma rays and various traits can be improved in various genotypes through various gamma rays doses.

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