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EFFECT OF RADIATION ON POLLEN AND SPIKELET FERTILITY IN RICE

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Abstract. Dry seeds of rice variety 370-Basmati were exposed to fast neutron doses ranging from 1.0 to 2.5 kR and gamma-rays from 15 kR to 30 kR, and the data on pollen and spikelet fertility were recorded in M_1 generation. There was a very high negative correlation between the radiation dosage and the fertility on pollen grains and spikelets. Neutrons had more serious effect than gamma-rays.

Proper information about the relative biological effectiveness of fast neutrons and gamma-rays and the differences in the radiosensitivity of different varieties of plants is very useful in mutation breeding work. Matsumura[4] compared the effects of neutrons, X and gamma irradiation on the growth of seedling, seed fertility and chromosome aberrations of treated M_1 plants of *Triticum* species and found that neutrons were more effective in causing chromosomal aberrations as compared to gamma-rays. Similar results have also been reported by Ehrenberg and Nybom,[1] Nybom[8] and Wettstein *et al.*[11] who studied the effects of neutrons and X-rays, and found neutrons more effective in inducing chromosome aberrations.

In our work we used the pollen fertility and spikelet fertility in seed irradiated plants of rice for comparing the effectiveness of neutrons and gamma-rays.

Materials and Methods

Rice seeds of variety 370-Basmati were dessicated for a week to make the water content uniform at 13%. The seeds were got irradiated from the International Atomic Energy Agency Laboratories, Vienna, Austria. The doses given were 1.0, 1.5, 2.0 and 2.5 kR of fast neutrons and 15, 20, 25 and 30 kR of gamma-rays. The irradiated seeds were soaked in water for 24 hr and then sown in seed bed. The seedlings were transplanted in the main plots after 30 days of seeding. The pollen fertility was determined by staining the pollen grains with 1% acetocarmine solution.[9] About 500 pollen grains per treatment were counted for testing the pollen fertility. For spikelet fertility, four main panicles from each plant were collected at random at the time of maturity. Seed viability was tested by growing them in petri dishes.

The data on pollen and spikelet fertility were transformed into Arcsin $\sqrt{\text{percentages}}$ and were analysed statistically for determining the correlation and regression coefficients.

Results and Discussions

The transformed data on pollen and spikelet fertility are presented in Table 1. It is evident from the Table that the coefficient of linear correlation ($r > -0.9$) is very high in all cases. Linear regression line was fitted between radiation doses and pollen and spikelet fertility. Figure 1 shows that with the increase in radiation dose, the fertility decreased correspondingly. The decrease in fertility is obviously due to some injurious effects of irradiations. The increase in mutation frequency has been shown to be accompanied by injuries in M_1 plants.[2] By that analogy it can be concluded that fast neutrons are more effective in increasing the mutation frequency. This observation is in agreement with the results obtained by Nilan *et al.*[7] From the data given in Table 1 it can be seen that the pollen fertility decreased in linear order with the increasing dosage of neutrons and gamma-rays. At the highest doses of 2.5 kR of fast neutrons and 30 kR of gamma-rays, the reduction in pollen fertility was generally accompanied with some sort of deformation in the shape of sterile pollen grains (Fig. 2).

The spikelet fertility following neutron irradiation decreased proportionately with the increase in dosage. In case of gamma-rays, there was a proportionate decrease in the fertility up to 25 kR whereafter it showed a slight insignificant increase at 30 kR. This could possibly be due to the elimination of unadaptable mutations at higher doses.[6] A few abnormal

TABLE 1. EFFECT OF FAST NEUTRONS AND GAMMA-RAYS ON POLLEN AND SPIKELET FERTILITY IN 370-BASMATI RICE.

Radiation dose (R)	Pollen fertility Arcsin$\sqrt{x\ \%}$	Coefficient of linear correlation (r)	Spikelet fertility Arcsin$\sqrt{x\ \%}$	Coefficient of linear correlation (r)
Gamma-rays				
Control	96.81		72.80	
15000	85.82		56.38	
20000	85.58	-.9774	49.00	-.9235
25000	77.21		46.87	
30000	73.36		50.63	
Fast neutrons				
1000	78.03		49.47	
1500	73.08		40.13	
2000	59.49	-.9868	35.70	-.9690
2500	44.51		32.63	

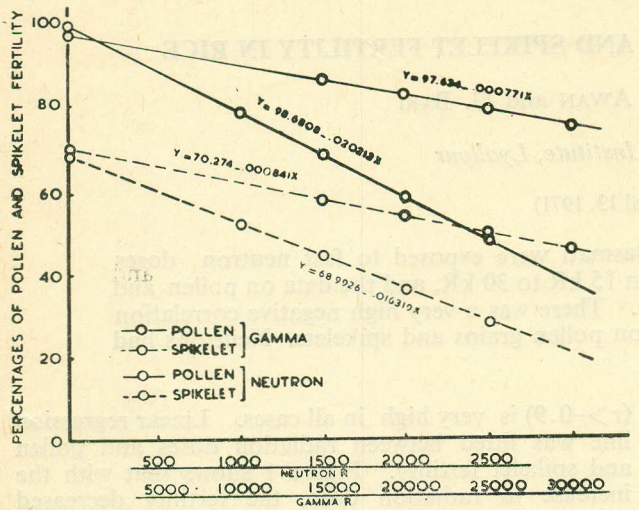

Fig. 1. Effect of neutrons and gamma-rays on pollen and spikelete fertility.

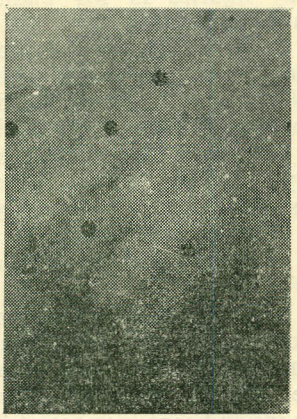

Fig. 2. Some sterile and deformed pollen grains alongwith normal ones observed in irradiated material.

plants, with no fertile spikelets, were also observed in higher doses of irradiation (Fig. 3). These abnormalities could be attributed to irregular cell division induced by radiation and the consequent failure to grow out as normal spikelets.[10] Kivi[3] also observed a number of abnormal plants with complete sterility in gamma and X-rays treated M_I barley. The sterility produced in rice by irradiation is thought to be due to chromosomal aberration.[5]

From the results reported here, it can be concluded that fast neutrons are more effective than gamma-rays in inducing pollen and spikelet sterility in rice. It may be pointed out that this sterility in M_I generation

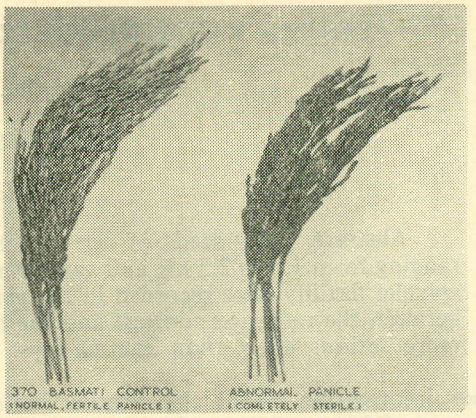

Fig. 3. Left, control; right, a completely sterile panicle with deformed floral organs caused by irradiation.

is not a barrier in rice breeding. It can be eliminated in subsequent generations through selection programmes.

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