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MUTATION IN FRUIT PLANTS USING IONIZING RADIATION AND CREATION OF PROMISING VARIETIES

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Abstract
This article discusses the experiment of inducing mutations in seed and drupe plants using X-rays, the results and scientific news, the effect of different doses of radiation on growth, and the selected promising varieties.

Keywords mutation, X-rays, fruit plants, breeding, plant genotype, pecan, date, pomegranate, apple, lemon.

Introduction

One of the important directions of agriculture today is the creation of new varieties of plants with valuable properties such as high yield, resistance to various stress factors, and product quality. The creation of new varieties through natural selection is a long-term process. Therefore, the method of creating new varieties by artificially inducing mutations (mutational selection) is of great importance in the field of agriculture. This method uses physical mutagens, such as ionizing radiation (X-rays, gamma rays).

In recent years, due to global climate change, water resources have decreased and the spread of various phytopathogens has increased, resulting in a sharp increase in the demand for stress-resistant and high-yielding varieties. Therefore, the importance of creating new and promising varieties under the influence of ionizing radiation is increasing. In this study, the prospects for inducing beneficial mutations in valuable fruit plants such as apple, pomegranate, date, lemon and pecan using X-rays and using them in breeding processes were studied on a scientific basis in the conditions of the Surkhandarya region of Uzbekistan.

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Many studies have been conducted on the theoretical and practical basis of mutational selection in the practice of world selection. The scientific analysis of these studies is as follows:

According to research by Kunzang Lamo et al., mutations cause various genotypic and phenotypic changes in plants. The authors have thoroughly analyzed the possibilities of creating beneficial mutations in fruit crops by ionizing radiation and their role in plant selection. In this study, the theoretical basis of the mutation screening process and its practical results are presented in detail (1).

The methodological manual "Methodology of calculations and phenological observations in experiments with fruit and berry plants" developed by Buriev et al. provides methodological guidelines for determining the growth phases of plants, comparing varieties, and correctly implementing selection selection. These methodological guidelines form the methodological basis of our research (2).

In his book "Methods of Breeding Fruit and Nut Crops", Witkowski provided comprehensive information on mutation breeding methods in fruit plants, the management of genetic variability, and the economic value and importance of new varieties created through mutations in breeding processes. This source provides an in-depth discussion of the genetic analysis of mutations, the process of phenotypic selection, and its role in breeding (3).

Studies by Singh and Bhatia have demonstrated the effectiveness of plant mutational selection through physical mutagens. The authors analyzed in detail the characteristics of the phenotypic and genetic changes caused by X-ray and gamma rays doses and exposure time in plants. The results of this study provide important theoretical and practical implications for the research we conducted (4).

Research goal: To accelerate the selection process by inducing mutations in fruit plants using ionizing radiation and selecting individuals with beneficial phenotypic changes.

Research method. The research was conducted based on the “Method and program for studying varieties of fruit and nut plants” (Michurin, 1973), and “ Study of mutations in fruit crops: a review” (Kunzang Lamo et al., 2017). 100 seeds from each plant species were selected and subjected to X-ray irradiation in 9 variants at a voltage of 45–80 kV.

Scientific novelty. The possibility of artificially inducing mutations using X-rays was successfully tested. Various phenotypic changes were observed in seedlings

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obtained from seeds irradiated at various doses and intensities. In some cases, the growth rate, germination percentage, and number of healthy seedlings were significantly higher than in the control group.

Practical significance : The results of the study are of great importance for the rapid development of productive, stress-resistant and marketable varieties of fruit crops in the subtropical and semi-subtropical regions of Uzbekistan, including pomegranate, date, lemon and pecan. Especially in hot climatic conditions such as Surkhandarya region, where there is sufficient irrigation water and factors affecting productivity, it is possible to increase agricultural efficiency by introducing new genotypes obtained through mutation into practical selection.

Research results. 100 seeds from each plant species were selected. Sorted seeds were placed in a stationary X-ray machine at 20, 40, 63 mAs (milliampere second) and three different voltages of 45, 65, 80 kV (kilovolts). Seeds were exposed to X-rays in 9 variants, variant 10 was taken as a control variant and was not exposed to X-rays.

Table 1 .**X-ray exposure to seeds i.**

Option	Voltage (kV)	mAs	Seeds number	Dose (mGy cm²)
I	45	20	100	454
II	45	40	100	850
III	45	63	100	1304
IV	65	20	100	1388
V	65	40	100	2455
VI	65	63	100	3972
VII	80	20	100	2235
VIII	80	40	100	4228
IX	80	63	100	5840
X (control)	0	0	100	0

As shown in the table, the radiation doses (mGy cm²) given to the seeds increase significantly with increasing X-ray voltage and mAs values. At low voltage (45 kV) the dose increased from 454 to 1304, at medium voltage (65 kV) from 1388 to 3972, and at high voltage (80 kV) from 2235 to 5840. The control variant represents samples not exposed to X-rays and has a dose value of zero. This table is the main reference for determining the physical mutagenicity used in the study.

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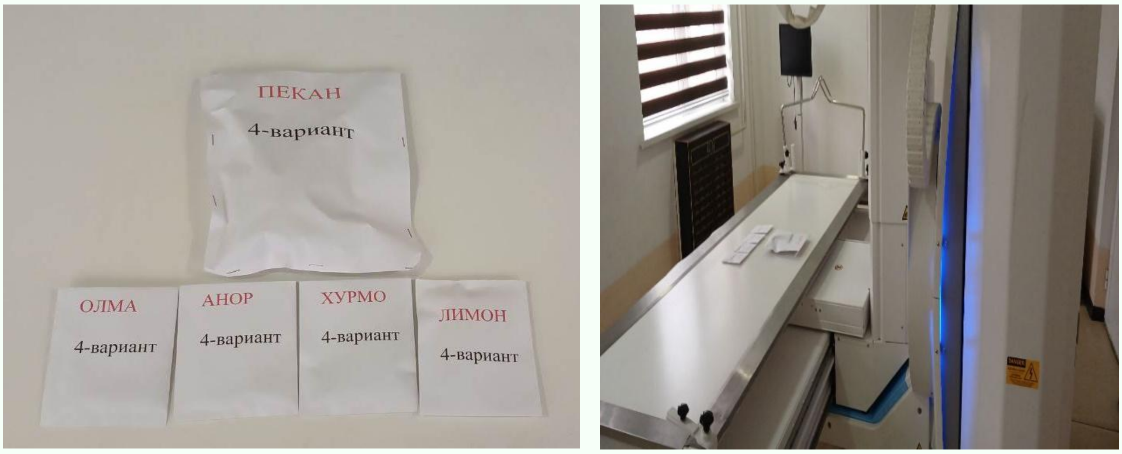

Figure 1. The process of exposing seeds to X-rays.

The data presented in the table show the effect of different doses of X-rays on the germination percentage and the growth length of seedlings. Specific results were observed depending on the type of seeds:

- **Lemon seeds** showed a maximum of 28% bruising in variant 1. This indicates that lemon seeds are sensitive to X-ray radiation and have an active physiological response to moderate levels of radiation.
- **Pomegranate seeds** showed high physiological activity with 18% germination and 22.44 cm growth length in variant 3. This result indicates that selection work can be accelerated by finding the optimal mutagen dose in pomegranate plants.
- **Date seeds** achieved 17% germination in option 9. This option is one of the highest (80 kV, 63 mAs) radiation levels, indicating that dates, which are subtropical plants, also show partial tolerance to high radiation.
- **Apple seeds** scored the lowest with only 8% bruising in option 8. This indicates that apple seeds are sensitive to some levels of X-ray radiation and are prone to potential damage.
- **Pecan** , on the other hand, gave the highest result among all species with 100% germination in variant 4. This indicates that it has a highly resistant genotype and a strong potential to convert mutagenic effects into resistant changes.

Overall, these results demonstrate the importance of determining **the appropriate mutagen dose for each plant species** , which will help improve the efficiency of selection and mutation studies.

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Table 2 The germination of plant seeds under the influence of X-rays

Plant	Number of seeds planted	Maximum bruising (%)	Bruising option	Bruise length (cm)
Apple	100	8	VIII -option	12.75
Pomegranate	100	18	Option III	22.44
Date	100	17	IX -option	9.7
Lemon	100	28	Option I	7.63
Pecan	25	100	Option IV	20.15

The results of the study show that X-rays had different effects on seed bruising. Significant differences in the percentage of bruising and growth length were observed in different plants depending on the radiation dose and voltage level.

Figure 2. Seedling growth

Apple seeds in variant 8 showed 8% germination, which is a higher result than in the other variants. In the other variants, no germination was observed at all, which indicates that seeds were injured or weakened by high or low radiation.

pomegranate seeds was 18% (variant 3), and seedlings grew to 22.44 cm. This indicator indicates an increase in physiological activity under the influence of radiation.

date palm seeds, variant 9 showed a 17% germination rate, with seedlings growing an average of 9.7 cm tall. This suggests that growth rates can be increased through mutations in subtropical plants such as the oriental date palm.

Lemon seeds showed a 28% germination rate in variant 1, indicating that lemon seeds are more sensitive to mutagenic effects. In other variants, growth rates of around 12–22% were observed.

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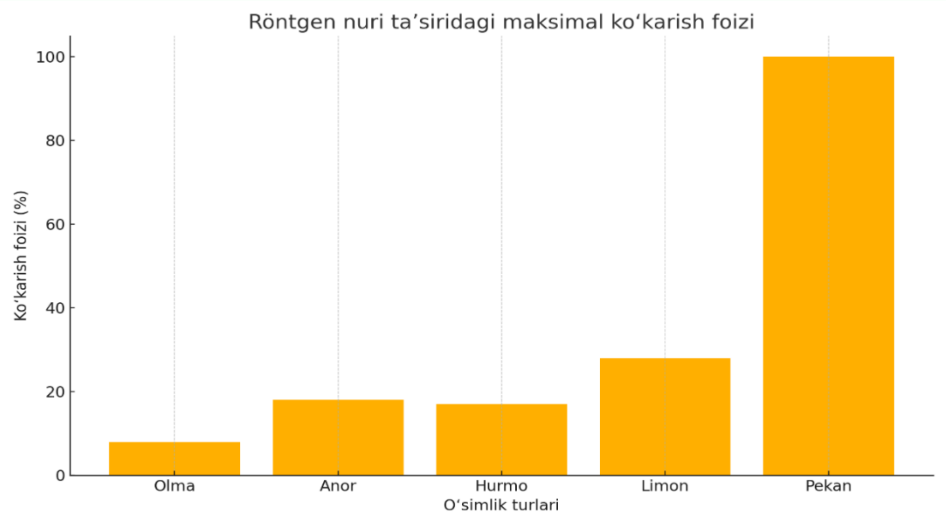
Pecan nuts showed the best results: 100% germination and an average growth of 17.64 cm were recorded in variant 4. Also, variant 5 recorded a growth of 20.15 cm with 76% germination. This indicates a high tolerance of pecan seeds to mutagenic effects.



3 . The percentage of bluing of irradiated accents.

Conclusion

Tabular and graphical analyses show that X-rays at a certain dose not only increased the germination percentage of seeds of many plants, but also improved the growth length. These results are of great importance for accelerating breeding work, especially in plants such as pomegranate and pecan. In the future, it is possible to achieve even more effective results by determining the absolutely optimal radiation dose for each plant species.

List of Used Literature

1. Kunzang Lamo et al. "Study of mutations in fruit crops: a review", Tashkent, 2017, pp. 12-35.
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