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IMPACT OF RADIOACTIVE CONTAMINATION ON THE GENETIC APPARATUS OF SOME PLANTS

I.Y. Fridunbeyov

Baku State University, MSE AR
f.ismayil@mail.ru

Abstract: This work studies the effect of radioactive contamination on the genetic apparatus of *Zygophyllum fabago* L. To assess the biological effect of radiation on plants, cytogenetic effects were studied, which are a sufficiently accurate and fast test for assessing the effectiveness of radiation and a criterion for its mutagenic effect. The results of the experiments showed that there is a certain relationship between a decrease in the viability of seeds and genetic disorders that arise in them during chronic irradiation. In particular, a decrease in the level of proliferative activity of cells, and death of cells with aberrations can cause growth inhibition.

Keywords: radioactive contamination, radiation, cytogenetic analysis, chromosome aberrations, biological effect

1. Introduction

In case of radioactive contamination of the environment resulting from the growth of industrial production, nuclear power, and chemicalization of agriculture, organisms are exposed to long-term chronic irradiation. The study of its consequences is of great importance for identifying ways of protection against it and adaptation to it at the organismic and population levels [1, 2].

An increase in the radiation background was also observed on the territory of the Absheron Peninsula in connection with the ongoing oil and gas developments, etc. So, in the village of Ramana, on the territory of the Iodine Plant, which is currently not operating, the background radiation was quite mosaic and in different areas ranged from 4-10 μR / hour to 150-220 μR / hour.

A comparative study of the viability of seed progeny of plants from areas with low and high radiation background, the level of proliferative activity and cytogenetic effects in the cells of the root meristem, as well as the formation of magnetite nanoparticles in seeds, their membranes and plant leaves was carried out.

2. Material and methods

The objects for research were seeds and leaves of plants of the species *Zygophyllum fabago* L. (green leaf) grown in areas with high and low radiation backgrounds.

To study the viability indices, cytogenetic analysis of the mutation process, and analysis of EPR spectra, seeds were collected from 20-25 plants from each plot. Laboratory germination and survival of seeds, dynamics of seedling growth, namely, the average length of roots, and the frequency of distribution of roots of different lengths were used as indicators of seed viability.

The experiments were carried out in 4 replicates, 100 seeds in each. The criterion for cytogenetic effects was chromosome aberrations in the ana- and telo-phase cells of the first mitoses of the root meristem. All the data obtained in the experiments were processed by generally accepted methods of statistical analysis for large samples [3, 4, 5].

Table 1

Viability of seed progeny of plants *Zygophyllumfabago* L. with low and high radiation background

Radiation background of the site	Sown seeds	Laboratory germination,%	Seedling survival,%	Measured seedlings	The average length of roots, mm
4,4-10 μ R / hour	400	96.5 \pm 0.91	94.61 \pm 1.18	255	20.02 \pm 0.09
150-200 μ R / hour	400	87.51 \pm 1.65*	70.63 \pm 3.16*	204	10.25 \pm 0.06*

Note: *- the differences between the options are reliable ($p > 0.001$)

3. Results and discussions

The results of the analysis of the viability of seed progeny of plants grown under low and high radiation backgrounds are shown in Table 1. It follows from the data in the table that laboratory germination of seeds, and survival of seedlings under high radiation background are significantly lower than with low radiation, and the length of the roots turned out to be half as long. The low radiation background is practically close to the natural one, and therefore, long-term chronic irradiation of plants against a high background has a clear inhibitory effect, which is especially pronounced along the length of the roots. The inhibition of seed germination with a high radiation background is also confirmed by the frequency of distribution of roots of different lengths (fig. 1).

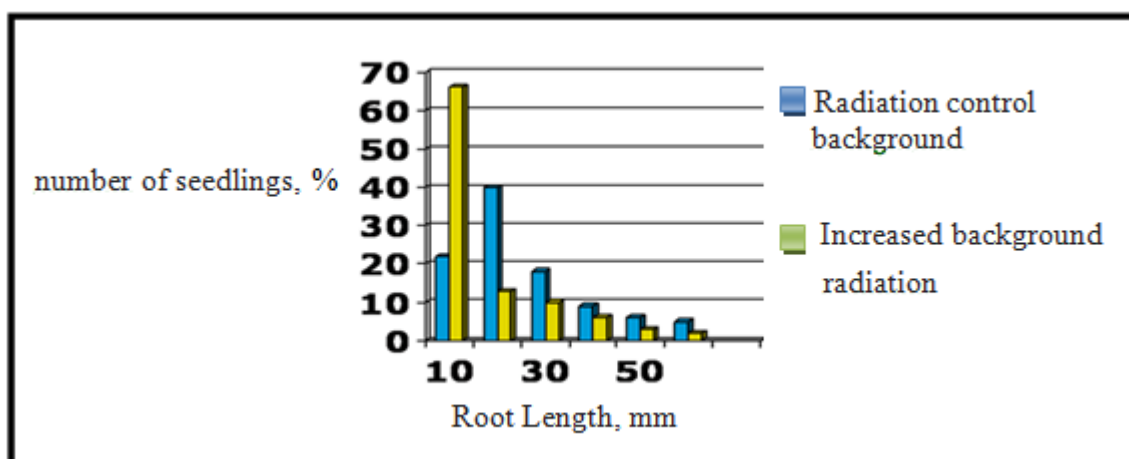


Fig. 1. Frequency of distribution of the number of roots of different lengths with high and low radiation backgrounds.

To assess the biological effect of radiation, it is important to study the cytogenetic effects, which are a sufficiently accurate and fast test for assessing the effectiveness of radiation and a criterion for its mutagenic effect.

For this purpose, we carried out a cytogenetic analysis of mitosis in the cells of the seedling meristem. The study of mitosis made it possible to assess the level of cell proliferation and the frequency of chromosomal aberrations in ana- and telo-phase cells. The results of the obtained data are shown in Table 2.

Table 2

Cytogenetic analysis of the proliferative activity of seedling meristem cells and the frequency of chromosome aberrations at low and high radiation background.

Radiation background of the site, $\mu\text{R} / \text{hour}$	Analyzed cells	Quantity dividing cells		t_d, P	Anaphase analyzed	Anaphase with rearrangements		t_d, P
		number	$\% \pm S \%$			number	$\% \pm S \%$	
4,4-10	1880	235	12.53 ± 0.08		170	5	2.94 ± 1.30	
150-200	2692	252	9.36 ± 0.31	$4.88 > 0.001$	249	48	19.27 ± 2.51	$5.79 > 0.001$

From the data in the table, it follows that with a high radiation background, there is a significant decrease in the level of cell proliferation and a significant (6.5 times) increase in the frequency of chromosome aberrations. To assess the biological effect of radiation, it is important to study cytogenetic effects, which are a sufficiently accurate and fast test for assessing the effectiveness of radiation and a criterion for its mutagenic action [6, 7, 8]. Thus, the results of experiments have shown that there is a certain relationship between a decrease in the viability of seeds and genetic disorders that occur in them with chronic exposure. In particular, a decrease in the level of proliferative activity of cells, and death of cells with aberrations can cause growth inhibition.

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ВЛИЯНИЕ РАДИОАКТИВНОГО ЗАГРЯЗНЕНИЯ НА ГЕНЕТИЧЕСКИЙ АППАРАТ НЕКОТОРЫХ РАСТЕНИЙ

И.Ю. Фридунбеков

Резюме: В данной работе изучается влияние радиоактивного загрязнения на генетический аппарат *Zygophyllum fabago L.* Для оценки биологического действия радиации на растения были изучены цитогенетические эффекты, которые являются достаточно точным и быстрым тестом для оценки эффективности радиации и критерий его мутагенного действия. Результаты опытов показали, что существует определенная связь между снижением жизнеспособности семян и генетическими нарушениями, возникающими в них при хроническом облучении. В частности, снижение уровня пролиферативной активности клеток, гибель клеток с абберациями могут вызывать торможение роста.

Ключевые слова: радиоактивное заражение, радиация, цитогенетический анализ, хромосомные абберации, биологический эффект

RADİOAKTİV ÇİRKİLƏNMƏNİN BƏZİ BİTKİLƏRİN GENETİK APARATLARINA TƏSİRİ

İ.Y. Fridunbəyov

Xülasə: Təqdim olunan işdə radioaktiv çirklənmənin *Zygophyllum fabago L.*-nin genetik aparatına təsiri öyrənilmişdir. Radiasiyanın bitkilərə bioloji təsirini qiymətləndirmək üçün sitogenetik təsirlər tədqiq edilmişdir ki, bunlar radiasiyanın effektivliyini qiymətləndirmək üçün kifayət qədər dəqiq və sürətli testdir. onun mutagen təsirinin meyarı. Təcrübələrin nəticələri göstərdi ki, toxumların həyat qabiliyyətinin azalması ilə onlarda xroniki şüalanma zamanı yaranan genetik pozğunluqlar arasında müəyyən əlaqə var. Xüsusilə, hüceyrələrin proliferativ fəaliyyətinin səviyyəsinin azalması, aberrasiyaları olan hüceyrələrin ölümü böyümənin ləngiməsinə səbəb ola bilər.

Açar sözlər: radioaktiv çirklənmə, radiasiya, sitogenetik analiz, xromosom aberrasiyaları, bioloji effekt