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Determination of the Activity of Soil of Cotton Fields and Cottonseeds in Some Regions of Uzbekistan

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Abstract: *In this research work, the radionuclide composition of soils of different regions (on the example of districts of Samarkand region) and the results of the experiment obtained with gamma-spectrometer of ^{40}K, ^{226}Ra, ^{232}Th and ^{137}Cs radionuclides, which can be accumulated in cotton seeds grown in the same soil, were studied.*

Keywords: —radionuclide; radioactivity; cottonseed; accumulation; contamination; gamma-spectra**.**

1. Introduction

Radionuclides which can be found in environmental samples include radionuclides of naturally radioactive uranium-thorium families (^{226}Ra, ^{222}Rn, ^{214}Rb, ^{214}Bi, ^{228}Ac, ^{212}Rb, etc.), natural radioactive isotopes of most chemical elements in the middle section of Mendeleev's periodic table (^{40}K, ^{87}Rb, ^{48}Ca, ^{176}Lu, ^{115}In, ^{138}La, etc.), cosmogenic (^{7}Be, ^{14}C, ^{3}H, ^{32}P, etc.) and man-made (^{137}Cs, ^{90}Sr, ^{89}Sr, ^{144}Ce, etc.) radionuclides. Natural nuclides of very long half-life that have existed since the creation of the Earth and their shorter-lived daughter nuclides. From the reaction of high-energy cosmic particles (protons, neutrons) falling from the space into atmospheric air in outer layers of the atmosphere (at an altitude of~9 km) with the nuclei of nitrogen, argon, oxygen and other gas atoms in the air, new, relatively light cosmogenic radionuclides are formed, and they merge with aerosols and fall into the surface of the Earth. Man-made radionuclides are products of nuclear fission, formed as a result of tests of nuclear weapons conducted in the atmosphere, explosions of nuclear devices, and are released into the environment under the influence of various climatic conditions, and radioactively contaminate natural samples [1-2]. Pollution of the environment with radionuclides poses a risk of their entry into the human body, mainly through food. The entry of radionuclides into the human body takes place through the food chain [3].

The plant world is one of the main sources in the transition of radionuclides into the organism of humans and animals. Plants play a key role in many food chains. Plants have the radionuclide-accumulating capacity in a state of aerosols, solutions, gases. Earth's outer layer plant radioactivity consists primarily of two constituents: aerosols, and plant roots. The first component determines the radioactivity of the Earth's crust. Radionuclides, which are in the air, accumulate and absorbs in leaves of the plant, the upper layer of its stem. In the second component, plants, trees, and shrubs accumulate water-soluble radionuclides from the soil through their roots in the form of their solution. Uranium, radium, potassium is also accumulated in the same way. The process of an accumulation from the soil is slow. Therefore, it is significant to accumulate radionuclides with greater half-life. [2].

Excessive accumulation of radionuclides in the human body beyond the permissible limits leads to the over-radiation of humans. It has been found that excessive radiation can lead to the emergence, development, and genetic changes in various life-threatening diseases (cancer, infertility, procreation, etc.) in healthy organisms. The radioactivity of environmental samples is not high. However, the repetitive effects of small doses of radiation on a living organism accumulate in the body. This effect is called cumulation. Changes in the blood also occur when a living organism is exposed to a small dose of 0.002-0.005 Gray of radiation per day. Therefore, it is important to determine the number of radionuclides that can be found in nature samples, in human consumption, in everyday products, in ensuring radiation safety of people.

Cotton is one of the dominant crop and integral to Uzbekistan's economy. From the cotton recycling process, various products are obtained, which are necessary for vital daily life processes and consumption. 100 kg cotton gives 62 kg of seeds and 37 kg of fiber. By the cotton recycling process, consumable products such as cottonseed oil, sorghum, cottonseed meal, and others can be obtained. Seed kernels contain (24 ÷ 29) % fat. Seed waste is processed and used to produce varnish, cellulose, and other products. Cottonseed oil is used for the preparation of natural and hydrogenated margarine, edible oils, soap, alif oil, and other products [4].

2. Sample preparation and measurement method

The soil obtained for the study and samples of seeds grown in this soil was dried at room temperature, cleaned of excess rocks and crushed. The measurements of the gamma spectra of the samples were performed in Marinelli beaker geometry on γ-spectrometer with NaI(Tl) scintillation detector, Ø 63 × 63 mm, an energy resolution of 10% on a gamma line ^{137}Cs with the energy of E = 661 KeV. Volumetric standard sources OMACH - ^{232}Th, ^{226}Ra, ^{40}K, and ^{137}Cs were used for calibration of the spectrometer in registration efficiency for γ- radiation of samples and for the decomposition of the spectra into components. Registration and processing of the spectra were done on IBM PC with the automatic writing of the spectra into the computer memory every hour which allowed us to control the stability of the spectrometer and correct the spectra when necessary. The measurement time was t=2 h.

3. Results and discussion

In the gamma-spectra of the investigated samples, the 1460 KeV peak of natural radioactive isotope ^{40}K was clearly demonstrated. The peaks of radionuclides of ^{228}Ac (911, 968 KeV), which belong to the Uranium-238 radioactive family and enter the chain of decay of ^{214}Pb (295, 351 KeV), ^{214}Bi (609, 1120, 1764 KeV) and thorium-232 family, were formed significantly, while ^{208}Tl (2614 KeV) formed unclearly.

From the analysis of the measured gamma-spectra of the samples, it can be seen that the radioactivity of the soils of the studied areas and the cotton seeds grown in these soils is defined by ^{226}Ra, ^{232}Th, and mainly ^{40}K and partially man-made ^{137}Cs radionuclides (Fig. 1,2). The specific activities of radionuclides were determined through the intensities of analytical gamma-lines, which differ from the background gamma-lines of the radionuclides detected in the gamma spectra of the studied samples. The results are given in the table.

The relative error of the measurement results in determining the specific activity of radionuclides was 10-14% in soils and 12-19% in seeds. The specific activities of radionuclides detected in the gamma spectrum of the samples are given in the table below, in Bk kg^{-1}.

Table 1:

№	The composition of the tested samples: Territories of the region		^{226}Ra	^{232}Th	^{40}K	^{137}Cs
1	Ishtikhon district	In the soil	41	38	621	15
		In the seed	8	7	304	4
2	Pastdargom district	In the soil	35	40	708	16
		In the seed	12	9	605	5
3	Jomboy district	In the soil	42	35	797	15
		In the seed	9	7	407	4

The intensities of radionuclides detected in the soils are 4-5 times higher than their intensities in the seeds. The highest activity in the soils and seeds corresponds to ^{40}K (Figure 1). (^{40}K) in the soils varies in the range from 621-797 Bk/kg, in seeds to 304-605 Bk/kg (Fig. 2). The reason for this is that the potassium element is distributed in large quantities (2,5%) in the Earth's crust, it can be considered that the soils are treated differently with potassium fertilizers, and the accumulation of potassium in the seeds is proportional to the amount in its soil. Potassium is an essential element in the life activities of living organisms. Potassium plays an important role in the metabolism of carbohydrates and proteins in plants, participates in the regulation of enzyme function, and a lack of potassium in food dramatically slows down the growth of the young organism. It has been found that the activity of nerve tissue in the body depends on the amount of potassium in it. Potassium has a significant effect on the metabolism of living organisms [2].

The ^{226}Ra radionuclide belongs to the ^{238}U radioactive family, which is relatively easily separated from rocks because the minerals are located outside the crystal lattice. The difference between the activities of ^{226}Ra detected in various soils is

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insignificant- (35-42) Bk/kg, which can be explained by the low leaching of ^{226}Ra from the soils. Similarly, the difference in ^{226}Ra activity detected in the seeds is also negligible (8-11) Bk/kg, indicating that the accumulation of ^{226}Ra in the seed is proportional to its amount in the soil. The activity values of ^{232}Th in various soils are comparable – (35-40) Bk/kg, although the variation in seed activity of ^{232}Th is not as large – (7-9) Bk/kg. From these results it is possible to draw such a conclusion, the amount of radionuclides ^{40}K, ^{232}Th, ^{226}Ra determined in seeds is almost proportional to the amount in their soil, but several times smaller than the amount in the soil: ^{226}Ra - 3-5, ^{232}Th - 4-5, ^{40}K - 1,2-2 times. The accumulation of various microelements, including radionuclides, in plants depends on several factors: the dependence of plants on their biological properties, structure, chemical composition of the soil, the amount of elements in the irrigated waters and other factors, determined by specialists [2].

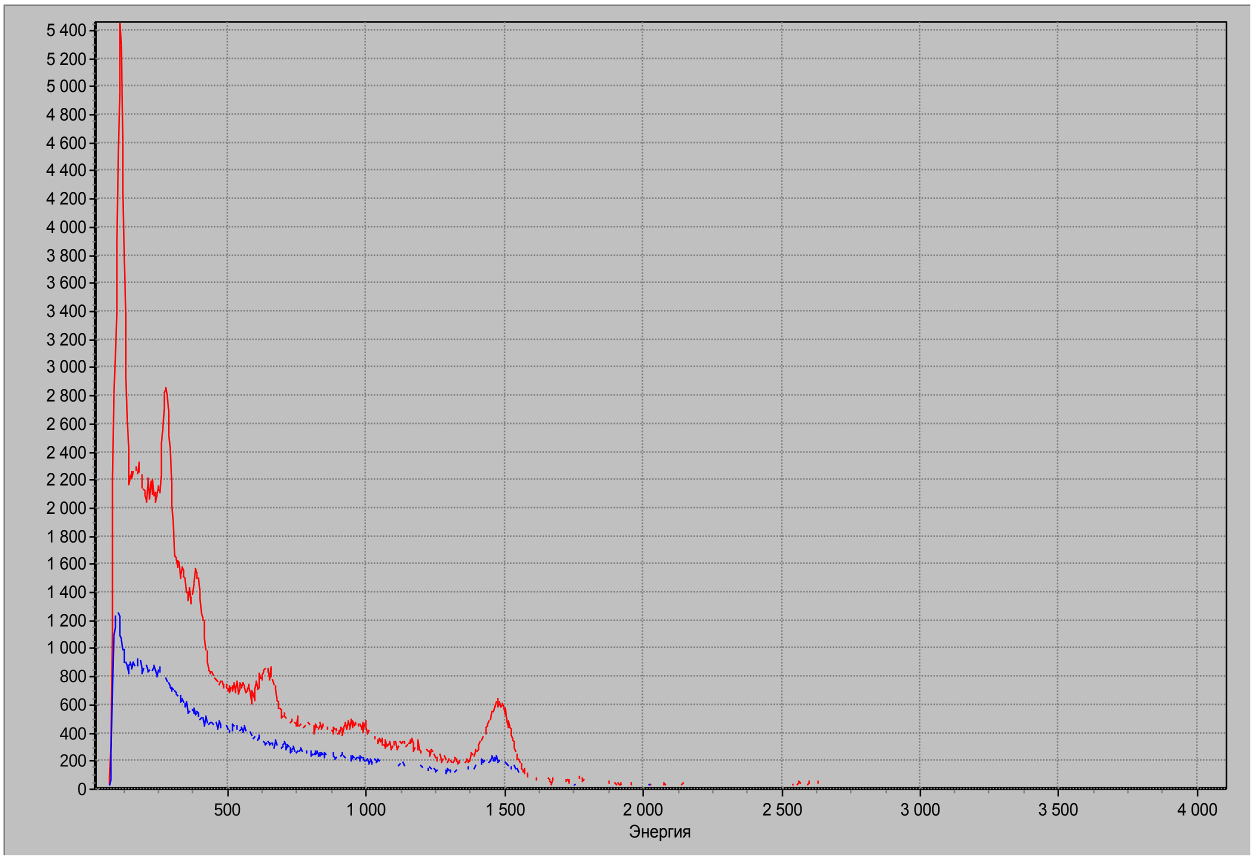

Figure 1. Gamma spectrum of the soil of Jambay district

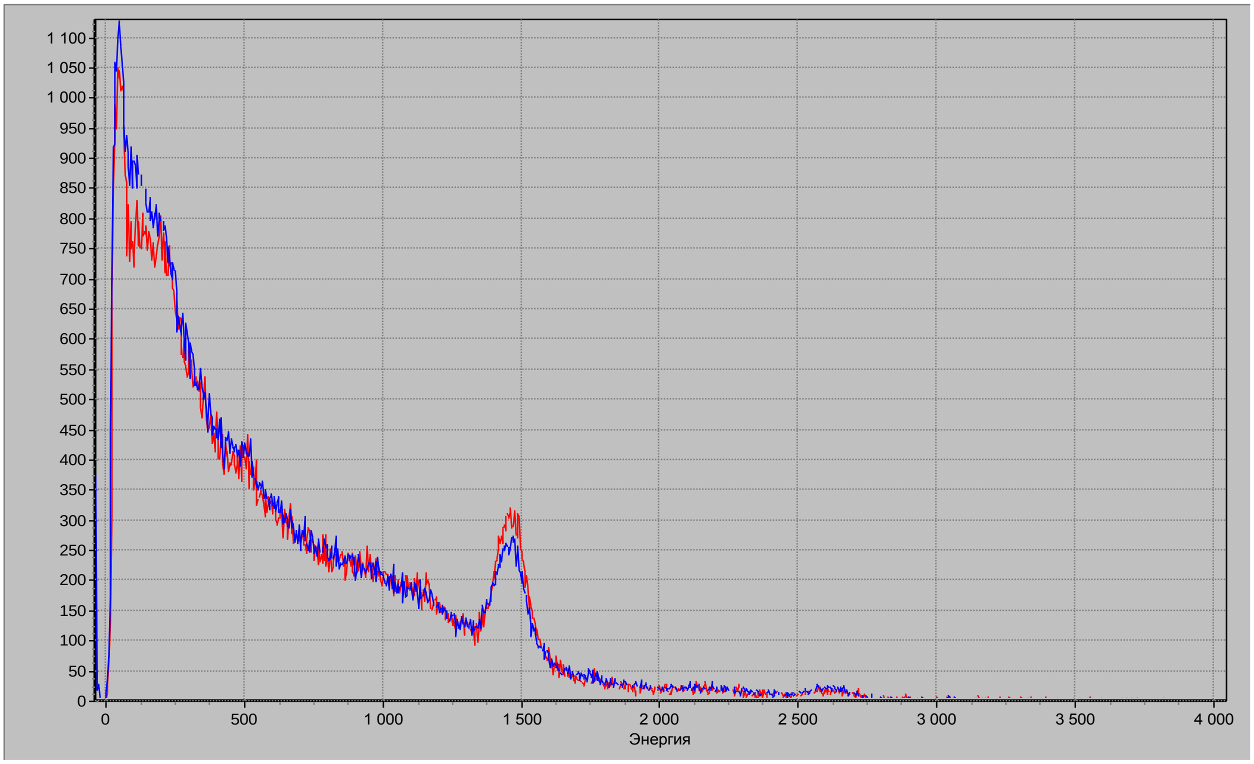

Figure 2. Gamma spectrum of the cotton seeds grown in soil of Jambay district

4. Conclusion

Results obtained indicate that, as determined by the gamma spectrum of research samples, the variation in man-made radionuclide ^{137}Cs is not significant (15-16) Bk /kg in soils collected from three different areas.The table shows that the accumulation of ^{137}Cs in seeds is proportional to its amount in the soil, but the accumulation in seeds is 3-4 times smaller than the amount in the soil.

The results obtained from the studies provide an opportunity to obtain information on the extent to which ^{226}Ra, ^{232}Th, ^{40}K natural radionuclides are distributed in the soils of the regions studied in this study, as well as the level of radionuclide accumulation in the cotton seeds. In similar soils, it is also possible to have information about the amount of man-made ^{137}Cs and the extent to which it passes into plants.

5. References

1. A.N. Azimov, A. Alibekov, N.N. Bazarbaev, I.T. Muminov, Radionuclides in the soils of the Karatepa mountains, Academy of Sciences of the Republic of Uzbekistan, Institute of Nuclear Physics, R-U-691, Tashkent-2010, 4-15 pp.
2. Pertsov, A.A. Ionizing radiation of the biosphere; Atom izdat: Moscow, 1973, 218, 26 - 97, 220, 236 - 248.
3. Vasilenko I.Ya. The biological effect of nuclear fission products. - Moscow: Binom, 2011.50-54pp.
4. National Encyclopedia of Uzbekistan. Volume 7, pp. 17-20, - Tashkent, 2004.