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Some Results of Radioecology Monitoring of Black Earth Soils of Georgia

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ABSTRACT

Based on radioecological monitoring data, the average content of ^{137}Cs and ^{90}Sr in 2019-2023 in the black earth soils of Georgia was studied. The obtained results are marked with the corresponding coordinates and given on the map. The average content of ^{137}Cs in black earth soils was determined to be 13.9 Bq/kg. The standard deviation is 14.0 Bq/kg. The content of ^{137}Cs in almost 95% of black earth soils does not exceed 32 Bq/kg. The average content of ^{90}Sr in soils is 4.1 Bq/kg. The highest ^{137}Cs contamination is recorded in the Samtskhe–Javakheti region of Georgia (Akhalkalaki, Akhaltsikhe, Vale, Ninotsminda, Adigeni, Aspindza, Akhaldaba). Radionuclides in the mentioned soils, namely ^{226}Ra content is 23 Bq/kg, ^{232}Th is 31 Bq/kg. As for ^{40}K-500 Bq/kg. The role of long-term decay products ^{210}Pb in the contamination of agricultural products is discussed.

Key words: *radioecology, soils, radionuclides.*

Introduction

Black soils are quite widespread in Georgia, both in eastern and western Georgia. Black soils are characterized by a large thickness of humus horizons and a high content of humus. These soils are characterized by high fertility and are intensively used for growing perennial crops and various agricultural crops (Akhalkalaki, Akhaltsikhe, Vale, Ninotsminda, Adigeni, Aspindza, Akhaldaba - Fig.1)

Materials and methods

After the accident at the Chernobyl power plant, soil radiation monitoring and environmental assessment of agricultural fields became important. Based on local monitoring data, we estimated the dose rate of gamma radiation exposure and the contamination levels of ^{137}Cs and ^{90}Sr in agricultural black earth soil types.

Agro-ecological soil monitoring and long-term observation system, determining the condition in space and time, beyond the processes and changes taking place in them, is the most important component of ensuring environmental safety [1]. The dynamics of radionuclide content was monitored at local monitoring reference sites. Constituent analyzes of the research are presented from 10 units. The dynamics of ^{137}Cs, ^{90}Sr, ^{226}Ra, ^{232}Th and ^{40}K in black soil were studied.

Results

Statistical processing of the data was carried out, the obtained results are presented in Table 1. The contamination with ^{137}Cs in black soils in the territory of Georgia does not exceed 31 Bq/kg. The average concentration of ^{90}Sr in the mentioned soils is 4.1 Bq/kg. The level of pollution is 1.2-5.1 Bq/kg. In the range. Studies indicate that the results are concentrated in the set near the mean value. Extreme values are quite rare. The average values of changes over time in the content of ^{137}Cs and 90Sr in black earth soils in

2019-2023 are presented in Fig. 1. The content of ^{137}Cs in the study soils in 2019 was 13.4 Bq/kg, slightly decreased in 2022 - 11.2 Bq/kg. And the content of ^{90}Sr in the same years was - 4.3 Bq/kg, later it decreased - 2.2 Bq/kg [2].

The half-life of the named radionuclide is equal to 30.0 years. The decrease of ^{137}Cs occurs in the spring, during the flood period, this season is characterized by the cleaning of contaminated areas from ^{137}Cs.

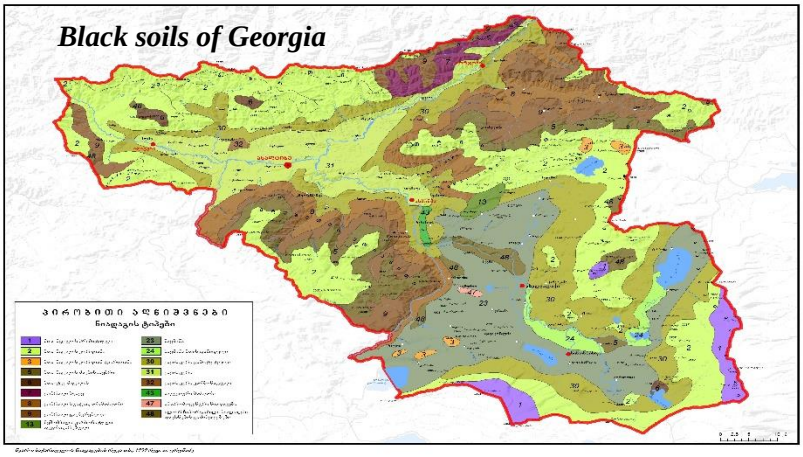

Fig.1. Black earth soils of Georgia.

By 2023, the radiation situation in the region will be improved, the radiation pollution levels of specific agricultural fields will decrease.

Transfer of ^{137}Cs from black earth soil to plants is the smallest compared to other types of soil. ^{137}Cs is involved in isotope exchange reactions in soil that occur as a mixture of potassium in soil-forming minerals and fertilizers. The content of ^{90}Sr in black soil in the area contaminated with ^{137}Cs is 2-26 Bq/kg. An important way of action is to reduce the contribution of radionuclides by humans to soils from the point of view of agriculture [3].

This study presents data from the statistical evaluation of all land soils. Analyzes were conducted at the Agricultural Research Center, the results are presented in Tables 1.

The decay products of long-lived elements - ^{226}Ra, ^{228}Ra, ^{210}Pb - have radiological importance and considerably more radiation.

Table 1. Levels of radionuclide contamination in the mentioned regions.

Sampling location	Radionuclide Content Bq/kg			Sampling location	Radionuclide Content Bq/kg		
	^{226}Ra	$^{232}Th(^{228}Ra)$	^{40}K		^{226}Ra	$^{232}Th(^{228}Ra)$	^{40}K
Akhalqalaqi	26.5	29.2	490	Adigeni	14.9	31.7	480
Vale	19.9	22.8	390	Aspindza	24.8	28.0	480
Adigeni	24.2	36.4	510	Akhaltsikhe	16.5	32.6	440

It should be noted here that the introduction of increased doses of mineral fertilizers into the soil creates desorption in the soil, which leads to an increase in radionuclides. In terms of radiation - ^{210}Pb is a very toxic radionuclide [4].

Conclusion

From the point of view of radiation safety, the conditions of provision should preferably be controlled - the content of ^{226}Ra in agricultural black soil.

Thus, the transfer of natural radionuclide isotopes from agricultural soils to plants was determined as ^{226}Ra and ^{228}Ra. High concentrations of these radionuclides in soil can lead to increased levels of contamination in food products.

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საქართველოს შავმიწა ნიადაგების რადიოეკოლოგიური მონიტორინგის ზოგიერთი შედეგი

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რეზიუმე

რადიოეკოლოგიური მონიტორინგის მონაცემებზე დაყრდნობით, შესწავლილია ^{137}Cs და ^{90}Sr-ის საშუალო შემცველობა 2019-2023 წლებში, საქართველოს შავმიწა ნიადაგებში. მიღებული შედეგები დატანილია შესაბამისი კოორდინატებით და მოცემულია რუკაზე. შავმიწა ნიადაგებში ^{137}Cs საშუალო შემცველობა დადგინდა 13.9 ბკ/კგ. სტანდარტული გადახრა არის 14.0 ბკ/კგ. თითქმის 95% შავმიწა ნიადაგებში ^{137}Cs-ის შემცველობა არ აღემატება 32 ბკ/კგ. ^{90}Sr -ის საშუალო შემცველობა ნიადაგებში არის 4.1 ბკ/კგ. ^{137}Cs-ის ყველაზე მაღალი დაბინძურება ფიქსირდება სამცხე-ჯავახეთის რეგიონში (ახალქალაქი, ახალციხე, ვალე, ნინოწმინდა, ადიგენი, ასპინძა, ახალდაბა). აღნიშნულ ნიადაგებში რადიონუკლიდები, კერძოდ ^{226}Ra - შემცველობა არის 23 ბკ/კგ. ^{232}Th - კი 31 ბკ/კგ. რაც შეეხება ^{40}K-500 ბკ/კგ. გრძელვადიანი დაშლის პროდუქტების ^{210}Pb როლი, განხილულია სოფლის მეურნეობის პროდუქტების დაბინძურებაში.

საკვანძო სიტყვები: რადიოეკოლოგია, რადიონუკლიდები, ნიადაგები

Некоторые результаты радиоэкологического мониторинга черноземных почв Грузии

С. Матиашвили З. Чанкселиани

Резюме

По данным радиоэкологического мониторинга в черноземных почвах Грузии в 2019-2023 гг. изучено среднее содержание ^{137}Cs и ^{90}Sr. Полученные результаты отмечены соответствующими координатами и указаны на карте. Установлено, что среднее содержание ^{137}Cs в черноземных почвах равно 13.9 Бк/кг. Стандартное отклонение составляет 14.0 Бк/кг. Содержание ^{137}Cs почти в 95% черноземных почв не превышает 32 Бк/кг. Среднее содержание ^{90}Sr в почвах составляет 4.1 Бк/кг. Наибольшее загрязнение ^{137}Cs зафиксировано регионе Самцхе-Джавахети Грузии (Ахалкалаки, Ахалцихе, Вале, Ниноцминда, Адигени, Аспиндза, Ахалдаба). Содержание радионуклидов в указанных почвах, а именно ^{226}Ra, составляет 23 Бк/кг. ^{232}Th составляет 31 Бк/кг. Что касается ^{40}K -500 Бк/кг. Обсуждается роль продуктов длительного распада ^{210}Pb в загрязнении сельскохозяйственной продукции.

Ключевые слова: радиоэкология, почвы, радионуклиды.