V. Melnyk, PhD student
T. Kurbet, PhD in Agr. Sc., As. Prof., research advisor
S. Kobzar, Senior Lecturer, language advisor
Zhytomyr State Technological University

ACCUMULATION OF ^{137}CS BY MOSS LAYER IN FRESH PINE FORESTS OF UKRAINIAN POLISSIA

As a result of the accident of Chernobyl NPP, the territory of Ukraine has undergone the contamination by radioactive isotopes, primarily ^{137}Cs. Considerable amount of radioactive emissions was accumulated by woodlands that have become a natural barrier to the spread of radioactive isotopes. The total area of radioactive contamination of the territory of Ukraine by ^{137}Cs in forests constitutes 39% of the total forest areas. [2, p. 63; 6, p. 23].

In the first years after the accident, scientists conducted a wide-ranging monitoring to assess the radiation situation in forests. Later, the researchers focused on the distribution of radioactive elements in forest ecosystems [4, p. 96; 7, p. 15]. Regularities investigation of the distribution of ^{137}Cs in different components of forest ecosystems is of great interest both in theoretical and practical aspects [3, p.134]. Mushrooms, lichens and moss accumulate ^{137}Cs by 1or 2 factors of ten more compared to its concentration in soil [4, p. 115]. Depending on the development and degree of projective coverage, the moss cover accumulates 0,08 -5,85% of the total amount of ^{137}Cs in biogeocenose. Researchers note [1, p. 30; 5, p. 58] that the contribution of mosses to the contamination of forest ecosystems reaches 12%. Therefore, the study of mosses as the accumulator of ^{137}Cs is relevant.

The purpose of our research was to study the accumulation of ^{137}Cs by moss layer in fresh pine forests at different density of radioactive contamination of soil. The studies were conducted in 2016 in Narodychi forestry (SP №1) and Malin forestry (SP №2) in pine plantations of 95-100 years old. The density of soil radioactive contamination on sample plot №1 (quarter 58, ground 6) was 259±16 kBq/m^2, and the sample plot №2 (quarter 60, ground 8) – 5,67±0,73 kBq/m^2. Moss layer was presented by Dicranum polysetum Sw. and Pleurozium schreberi with projective cover of 85-90%. Projective cover assessment was made by using the grid of Ramensky (1m x 1m). A full cut of a moss layer was made and soil samples were taken from each square metre. The samples of moss were divided into apical portion (live), average (dead) and lower (combings). All samples were dried to air-dry state, crushed and brought to a homogeneous state. Measuring the specific activity of ^{137}Cs in the samples was performed with a scintillation gamma spectrometry device with multi-channel pulse analyzer (AI).

While studying the radioactive contamination of mosses by ^{137}Cs, it was found that the exceeding value of specific activity for Dicranum polysetum compared to Pleurozium Schreberi was observed in each sample plot. It was found that the concentration of ^{137}Cs in Dicranum polysetum on SP №1 and SP №2 constitutes 12196,5±949,3 Bq/kg and 291±16,4 Bq/kg, whereas for Pleurozium Schreberi the corresponding values are equal 6161,2±296,6 Bq/kg and 246,5±7,95 Bq/kg. The existence of significant differences between average values of specific activity of ^{137}Cs is confirmed by the single-factor analysis of variance: for SP №1

$F_{act.}=51,79 \geq F_{(1;48;0,95)}=4,04$; for SP №2 $F_{act.}=4,36 \geq F_{(1;37;0,95)}=4,11$. Consequently, reliable at the 95% confidence level exceeding concentration of ^{137}Cs in Dicranum polysetum compared to Pleurozium Schreberi in SP №1 and SP №2 constituted 2,0 and 1,2 times respectively.

We also analyzed the radioactive contamination of different parts (fractions) of Pleurozium Schreberi and Dicranum polysetum (Table 1).

Table 1

Average values of specific activity of ^{137}Cs in moss fractions, Bq/kg

Moss species	Moss fraction					
	SP №1			SP №2		
	live	dead	combings	live	dead	combings
Dicranum polysetum Sw.	12089±1106	9317±956	14770±1604	296±37	240±11	338±23
Pleurozium schreberi (Brid.) Mitt.	5220±165	4924±151	7300±407	233±7	224±10	274±10

Both for Dicranum polysetum and Pleurozium Schreberi on SP №1 and SP №2 the maximum specific activity was observed for combings – 14770±1604 Bq/kg and 338±23 Bq/kg respectively. On SP №1 the specific activity values for live and dead moss fraction compared to combings were 1.2 and 1.6 times lower; on the SP №2 the difference was 1.1 and 1.4 times. Dead moss faction is characterized by the smallest accumulation of ^{137}Cs: for Pleurozium Schreberi specific activity constituted 7300±407 Bq/kg and 274±10 Bq/kg on SP №1 and SP №2 respectively. Excess values for the specific activity of live moss and combings fraction compared to the dead part of the SP №1 were 1.1 and 1.5 times, and the SP №2 such excess averaged 1.2 times. The results of the single-factor analysis of variance show that there is a significant difference between the average values of specific activity of ^{137}Cs different moss fractions (live part - dead part - combings) on each sample plot. On SP №1 for fractions of Pleurozium Schreberi and Dicranum polysetum $F_{act.}=14,15 \geq F_{(2;29;0,95)}=3,35$ and $F_{act.}=4,5 \geq F_{(2;18;0,95)}=3,63$; on SP №2 $F_{act.}=7,1 \geq F_{(2;14;0,95)}=3,9$ and $F_{act.}=3,96 \geq F_{(2;22;0,95)}=3,5$ respectively. It was found that the value of ^{137}Cs accumulation by moss fractions can be placed in ascending order: combings> live part> dead part.

Consequently, the results of our research, within a single type of forest-growing conditions at different density of radioactive contamination of soil, Dicranum polysetum is characterized by significantly higher levels of radioactive contamination compared to Pleurozium Schreberi (exceeding on SP №1 by 2 times, and on SP №2 by 1,2 times). Also it was found that the minimum concentration is typical for dead part of both moss species under study, and the maximum - for combings. Thus, the specific activity of ^{137}Cs in combings compared to the dead fraction for Dicranum polysetum and Pleurozium Schreberi on SP №1 was 1,6 and 1,5 times, on SP №2 - 1,4 and 1,2 times respectively.

REFERENCES

1. Gorbachev V.N. Soil-ecological studies in forest biogeocenoses / V.N. Gorbachev, V.K. Dmitrienko // Novosibirsk, 1982. - P. 128.

2. Kaletnik N.N. Radiological situation in the forests of Ukrainian Polissya / N.N. Kaletnyk, V.P. Landin, V.P. Krasnov, P.S. Pasternak, P.P. Podkur // Oykumena. - 1991. №2. - P.61-66.

3. Krasnov V.P. Applied forest radioecology / V.P. Krasnov, A.A. Orlov, V.A. Buzun, V.P. Landin, Z.M. Shelest / Under Ed. of Doctor of Agricultural Sciences V.P. Krasnov. - Monograph. – Zhytomyr: Polissia, 2007. - 680 p.

4. Krasnov V.P. Radioecology of forests of Ukrainian Polissya: monograph / V.P. Krasnov. - Zhytomyr, Volyn, 1998. - 112 p.

5. Kulikov N.V., Molchanova I.V., Karavaev E.N. Radioecology of soil and vegetation cover. - Sverdlovsk: UrO of the USSR Academy of Sciences, 1990. – 172p.

6. Scheglov A.I. Biogeochemistry of technogenic radionuclides in forest ecosystems. - Moscow: Moscow State University, 1999. - 268p.

7. Scheglov A.I., Tsvetnova O.B., Kuchma N.D. Distribution and Reserves of Cesium-137 in Components of Forest Ecosystems of Ukrainian Polissya // The problems of forest ecology and forestry of Ukrainian Polissya / Proceedings of Polissya LNDS. - Zhytomyr, Volyn - 1999 Issue 6. - P.12 -25