ASSIMILATION OF 134Cs FROM CONTAMINATED SOIL INTO CULTIVARS OF TRITICALE AND OATS

УСВОЯВАНЕ НА ^{134}Cs ОТ КОНТАМИНИРАНИ ПОЧВИ В РАЗЛИЧНИ СОРТОВЕ ТРИТИКАЛЕ И ОВЕС

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ABSTRACT

Pot experiments with different triticale and oats varieties spread in Bulgaria were carried out. Three varieties of triticale (Rakita, TC-210, AD-7291) and three varieties of oats (Obrazcov chiflik, W-!6 and W-17) were analized. The plants were grown on soil type Dystric planosol /FAO. The soil was contaminated with radionuclide ^{134}Cs.

It was established that the radiocesium is unevenly accumulated in the different parts of the plants. The highest ^{134}Cs concentration was found in the leaves and the lowest in the grains.

Variety differences of uptake of ^{134}Cs in investigated crops were established. The highest level of accumulation of the radiocesium has been detected in triticale variety Rakita, and in oats variety W-17.

It has been determined that the uptake of the radionuclide by plants of the triticale is more intensive then that of by the oats plants.

KEY WORDS: ^{134}Cs, plants, variety, transfer factor.

РЕЗЮМЕ

Проведени бяха съдови опити с различни сортове тритикале и овес, разпространени в България. Анализирани бяха 3 сорта тритикале: (Ракита, ТС-210, АД-7291) и 3 сорта овес: (Образцов чифлик 4, W-16 и W-17). Растенията бяха отгледани върху канелено подзолиста почва, контаминирана с радионуклида цезий-134.

Констатирано бе, че радиоцезия се натрупва неравномерно в различните органи на растенията. Най-висока концентрация бе установена в листата, а най-ниска в зърното на изследваните култури.

Установени бяха сортови различия в усвояването на ^{134}Cs от изследваните култури. Най-висока степен на натрупване на радиоцезия бе отбелязано при тритикале сорт Ракита, а при овеса в сорт W-17.

Наблюдавани са видови различия при натрупването на радионуклида в изследваните култури. Тритикалето има подчертана способност да извлича от почвата и акумулира радиоцезия в надземните органи по-силно от овеса

КЛЮЧОВИ ДУМИ: ^{134}Cs, растения, сорт, трансферен фактор

РАЗШИРЕНО РЕЗЮМЕ

Проведени бяха съдови опити с различни сортове овес и тритикале, разпространени в България. Анализирани бяха сортове овес: Образцов чифлик 4, W-16 и W-17 и сортове тритикале: Ракита, ТС-210 и АД-7291. Растенията бяха отгледани върху канелено подзолиста почва, контаминирана с радионуклида цезий-134. Експериментите бяха заложени във вегетационни съдове с вместимост 5 kg. почва при контролирани условия. Активността на цезий-134 в почвата беше 1,35 MBq/съд. Опитът е проведен в 4 повторения. След поникването на семената бяха оставени по 20 нормално развити растения във всеки съд. Опитните растения бяха отгледани до фаза пълна зрялост. На въздушно сухата растителна маса (листа, стъбла и зърна) бе извършено гама-спектрометриране с многоканална анализаторна система "Канбера" с германиев детектор с 20% ефективност и грешка на измерването под 10%.

За оценка на преминаването на радионуклида в различните органи на растенията бе използван"коефициент на натрупване", изразяващ отношението на активностите в 1g въздушно суха растителна маса и 1g почва.

От получените резултати при изследванията могат да се направят следните изводи:

1.Цезий-134 се разпределя неравномерно в различните органи на растенията. Най- голяма акумулация има във вегетативната маса, а най-слаба в зърното.

2. Установени са сортови различия при натрупването на радиоцезия във всички надземни органи на изследваните култури.

3. Сравнително най-висока степен на натрупване на цезий-134 бе отбелязано в тритикале сорт Ракита и овес сорт W-17.

4. Установени са видови различия при натрупването на радионуклида в изследваните култури. По-високи коефициенти на трансфер са отбелязани при тритикалето, като различията са най-силни в листната маса на изследваните сортове.

INTRODUCTION

There are data in literature about the influence of the soil properties, the species and sort varieties of the plants over the degree of assimilation of radionuclides [5]. The cultures differ up to 94 times [1, 4] as far as cesium-134 content in the economically valuable parts of the crops is concerned. The intersort fluctuations of the cultures with regard to radionuclides concentration may be 2-4 multiple [5].

The goal of the research conducted was to establish the extraction and the accumulation of radionuclide cesium-134 from contaminated soil in the vegetative and reproductive organs of different varieties from some cereal cultures.

MATERIAL AND METHODS

Pot experiments were carried out with different varieties of oats and triticale, widely distributed in Bulgaria. The following varieties were analyzed: of spring oats, cultivar Obrazcov Ciflic 4, W-16 and W-17 and sorts of triticale: Rakita, TC-210 and АД-7291. The plants were grown up on dystric planosol soil (FAO), contaminated with cesium-134 radionuclide. The agro-chemical characteristics of the investigated soil are indicated in Table 1. Dystric planosol soil was selected for the experiments as the factors of transfer with this type of soil are comparatively higher than those in other soil differences [6].

The experiments were set in vegetation vessels with capacity 5 kg. of soil under controlled conditions. The activity of cesium-134 in the soil was 1,35 MBq/pot. The experiment was carried out four times. After the growth of the seeds 20 normally developed plants were left in each vessel. Feeding up with mineral fertilizers and maintenance of 60 to 70 % soil humidity were applied during vegetation. The trial plants were grown up to the phase of full ripeness. The air-dried plant material (leaves, stems and grains) was analyzed by gamma-spectrometry using multi-channel analyzer "Canberra" with germanium detector (20% efficiency) and uncertainty less then 10%.

"Transfer factor" expressing the ratio of the activities in 1g air dry mass per 1g soil was used for the evaluation of the passing of the radionuclide in the various organs of the plants.

RESULTS AND DISCUSSION

The results of the analysis of the varieties of triticale under research grown over soil contaminated with cesium-134 are presented in Figure 1. Intense concentration of the radionuclide in the vegetative organs, leaves predominantly, is observed in all the variants. It is about 3 times bigger as compared with the stems and four times bigger in comparison with the grains.

The intersort comparisons with regard to the content of radiocesium in the leaves of the trial plants show differences up to 37%, and in the stems of about 22-28%. The comparatively strongest accumulation was stated with Rakita variety. In it the transfer factors in all plant organs are the highest / 0,4 for the grain; 0,47 for the stems and 1,54 for the leaves /. Sort TC-210 with Tf

Table 1: Agrochemical characteristic of the investigated soil.
Таблица 1: Агрохимическа характеристика на изследваната почва

Soil type /FAO	pH KCl	Humus %	Ca + Mg meq/100g	Ca meq/100g	K_2O mg/100g	Σ<0.01 mm
Dystric planosol	3,8	1,7	14,8	9,3	20,0	24,2

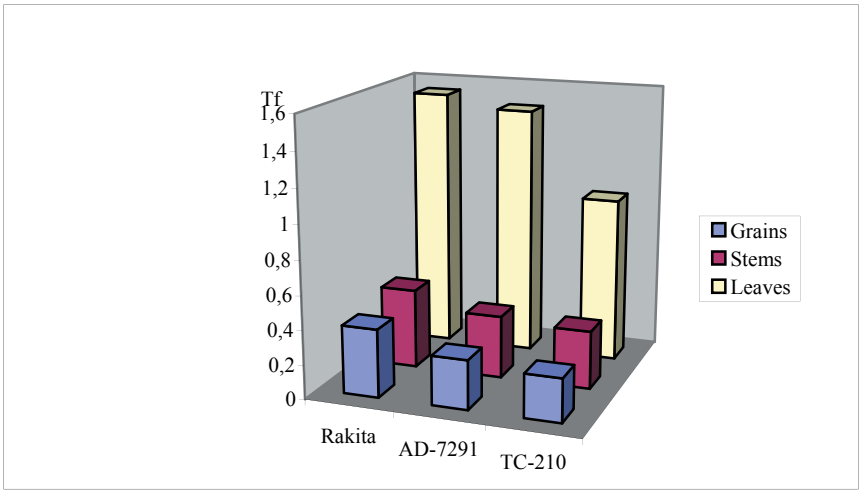

Fig.1: Assimilation of Cs-134 from different cultivars of triticale raised on soil Dystric planosol /FAO
Фиг.1: Усвояване на Cs-134 от различни сортове тритикале отгледани върху канелено подзолиста почва

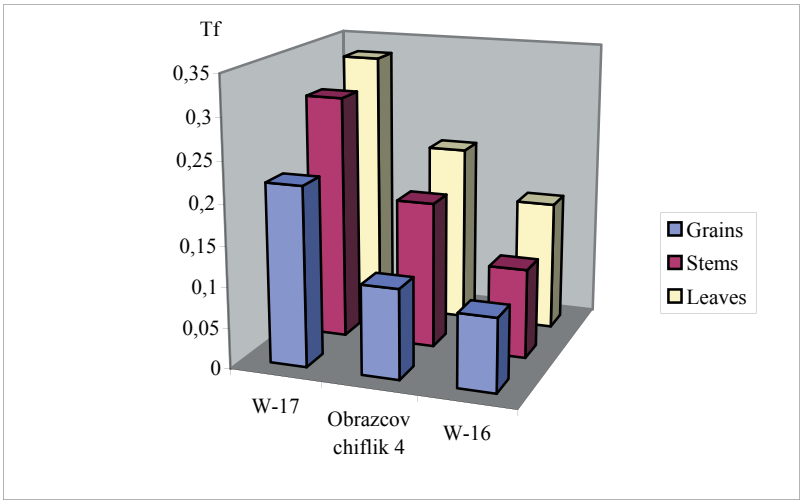

Fig.2: Assimilation of Cs-134 from different cultivars of oats raised on soil Dystric planosol /FAO
Фиг.2: Усвояване на Cs-134 от различни сортове овес отгледани върху канелено подзолиста почва

(transfer factor) in the grain, the leaves and the stems is with the lowest levels of accumulation, respectively 0,25; 0,34; 0,97.

Figure 2 represents the data about the stage of radioactive pollution with cesium-134 of 3 varieties of oats. The obtained results indicate significant differences in the contents of radio-cesium in the individual organs. In this culture, too, in all trial variants comparatively high accumulation of the radionuclide was stated in the vegetative plant organs – leaves and stems. The content in them is up to twice more in comparison with the grains. The radionuclide is comparatively low in accumulating in the grains for all researched sorts.

The differences in the content of cesium-134 in the individual plant organs are probably connected with the peculiarities of the movement this element in the plants and its re-distribution in the ontogenesis period [3].

In this culture there are clearly expressed intersort differences in the nuclide accumulation level - about 2-2,5 times. The highest accumulation per unit of dry material is observed in variety W-17. The highest Tf levels are also noted in it: 0,33 – for the leaves; 0,30 – for the stems and 0,22 for the grains. The comparatively lowest nuclide contents was established in variety W-16 with Tf in the leaves, stems and the grains respectively 0,16; 0,11; 0,09. The variety differences in the accumulation of radionuclides may be explained solely by genetic factors, determining the specifics of metabolism, inherent to all periods of ontogenesis [4].

The results obtained are in compliance with the statement of Gouliakin, Udinceva and other authors [2], that at transfer of radionuclides in epigeous organs of the grain crops a general rule is observed – their accumulation predominantly in the vegetative organs of the plants.

Comparing the results of the research with triticale and oats carried out, specific differences are established with regard to the accumulation of the radionuclide. Triticale has an underlined capacity to take up from the soil and accumulate the cesium in the epigeous organs more intensivly than oats.

CONCLUSIONS

1. Cesium-134 is unevenly distributed in the various plant organs. The highest accumulation is in the vegetative material and the lowest in the grain.

2. Variety differences were established in the accumulation of radio-cesium in all epigeous organs of the researched cultures.

3. The comparatively highest level of accumulation of cesium-134 was noted in triticale Rakita sort and oats sort W-17.

4. Specific differences were established in the accumulation of the radionuclide in the researched cultures. Higher coefficients of accumulation were noted in triticale, the differences being the greatest in the leave material of the researched sorts.

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