ACCUMULATION OF Cs-134 IN THE YIELD OF TRITICALE DEPENDING ON THE CULTIVAR AND THE SOIL TYPE

НАТРУПВАНЕ НА Cs-134 В ДОБИВА ОТ ТРИТИКАЛЕ В ЗАВИСИМОСТ ОТ СОРТА И ПОЧВЕНОТО РАЗЛИЧИЕ

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ABSTRACT

Pot experiments were carried out with three triticale cultivars spread in Bulgaria - Rakita, TC-210, AD-7291. The plants were grown on two soil types representative for our country - luvic phaeozem /FAO and dystric planosol /FAO. The soil was contaminated with the radionuclide Cs- 134.

It was established that the radiocesium is accumulated unevenly in the different plants parts. The highest Cs-134 concentration was found in the leaves and lowest in the seeds.

There are differences in the accumulation of Cs-134 in the plants depending on the soil type on which they were raised. It was determined that the uptake of the radionuclide from plants raised on dystric planosol soil was more intensive with comparison with those raised on soil luvic phaeozem. The highest level of accumulation of the radio Cs was established in cultivar Rakita, and the lowest - in cultivar TC-210 for the two soil types.

KEY WORDS: triticale, soils, radionuclid Cs-134, plants, transfer factor.

РЕЗЮМЕ

Проведени бяха вегетационни опити с три български сорта тритикале, разпространени в България – Ракита, ТС-210 и Ад-7291. Растенията бяха отгледани при контролирани условия на две представителни за страната почвени различия: излужен чернозем и канелено подзолиста почва, контаминирани с радионуклида Cs-134. Опитните растения бяха прибрани във фаза пълна зрялост. На въздушно-сухата растителна маса бе извършено гама-спектрометриране с многоканална анализаторна система “Канбера” с германиев детектор.

Констатирано бе, че съществуват различия при натрупването на цезий 134 в растенията в зависимост от почвения тип на който са отгледани. Най-висок коефициент на натрупване е отбелязан в листната маса на изследваните сортове и при двата почвени типа, а най-нисък в зърното. Сравнително най-висока степен на натрупване на радиоцезия е отбелязана при сорт Ракита, а най-ниска при сорт ТС-210 и за двете почвени различия.

КЛЮЧОВИ ДУМИ: натрупване, Cs-134, почви, радионуклиди, тритикале, коефициент на натрупване.

DETAILED ABSTRACT

Plant growth experiments were carried out under controlled conditions with two different characteristic for Bulgaria soil types: luvic phaeozem and dystric planosol. The soil was contaminated with an aqueous solution of Cs-134 with activity 1.35 MBq/per pot. The research was carried out with 3 cultivars of triticale, spread in Bulgaria: Rakita, TC-210, AD-7291. After the germination of the plants in each pot were left 20 normally developed plants. During the vegetation period the plants were treated with mineral fertilizers, in accordance with the respective standards for the experimental soil types. The process of vegetation till full ripeness lasts for 90 days. The epigeous parts of the plants (leaves, stem, seeds) were checked with a multi-channel gamma spectrometer CANBERRA with a Ge detector with effectiveness of 20 % and measurement error less than 10 %.

For the correct determination of the transition of the radionuclide from the soil to the plants a "Transfer factor" was introduced. The transfer factor expresses the relationship between the radionuclide activity in 1 g epigeous plant tissue and 1 g soil.

The present investigation was undertaken to study the transfer and accumulation of the radionuclide Cs-134 in the vegetative and reproductive plant tissues of different cultivars of triticale, spread in Bulgaria. Two soil types characteristic for Bulgaria were used for the research.

It was established that there were differences in the accumulation of Cs-134 in the plants depending on the soil type on which they were raised. It was determined that the uptake of the radionuclide from plants raised on dystric planosol soil was more intensive with comparison with those raised on soil luvic phaeozem.

The highest transfer factor was detected in the leaf tissue of the researched cultivars for the two soil types, and the lowest - in the seeds.

The highest level of accumulation of the radio Cs was detected in cultivar Rakita, and the lowest - in cultivar TC-210 for the two soil types.

INTRODUCTION

The accumulation of radionuclides via the root system depends on the species, as well as the cultivars, characteristics of the plants ([3}; [5]). According to the content of Cs-134 in the economically important parts of the yield, the crops share 94 differences ([1]; [6]). The variations of the different cultivars of the agricultural crops with respect to the concentration of radionuclides can be from 2 to 4 times ([9]). Dispersion ([2]) and the soil type and its physico-chemical characteristics exerts strong influence on the penetration of the radionuclides in the plants ([7,10]).

The present investigation was undertaken to study the transfer and accumulation of the radionuclide Cs-134 in the vegetative and reproductive plant tissues of different cultivars of triticale, spread in Bulgaria. Two soil types characteristic for Bulgaria were used for the research.

MATERIAL AND METHODS

Plant growth experiments were carried out under controlled conditions with two different characteristic for Bulgaria soil types: luvic phaeozem / FAO and dystric planosol / FAO. The mineralogical and chemical characteristics of the studied soils are given in Table 1. The soil was contaminated with an aqueous solution of Cs-134 with activity 1.35 MBq/per pot. Pots with capacity of 5 kg were used for the experiment and it was repeated 4 times. The research was carried out with 3 cultivars of triticale, spread in Bulgaria during the studied period: Rakita, TC-210, AD-7291. After the germination of the plants in each pot there were left 20 normally developed plants. During the vegetation period the plants were treated with mineral fertilizers, in accordance with the respective standards for the experimental soil types. The humidity of the soil was kept 60-70 %. The process of vegetation till full ripeness lasts for 90 days. The experimental plants were gathered in the phase of full ripeness. The epigeous parts of the plants (leaves, stem, seeds) were checked with a multi-channel gamma spectrometer CANBERRA with a Ge detector with effectiveness of 20 % and a measurement error of less than 10 %.

For the correct determination of the transition of the radionuclide from soil to plants a "Transfer factor" was introduced. The transfer factor expresses the relationship between the radionuclide activity in 1 g epigeous plant tissue and 1 g soil.

RESULTS AND DISCUSSION

The results of the analysis of the studied cultivars triticale, raised on soil luvic phaeozem are shown on Fig.1. They show considerable difference in the radionuclide's content in the different parts of the plant. Among all the studied cultivars, the greatest accumulation was detected in the leaves. The activity of the radio Cs in the leaves was about 4 times greater than that in the seeds and three times greater than that in the stems. The results showed that in comparison with the other examined cultivars, cultivar Rakita had the strongest ability to accumulate radio Cs. There was not a significant difference in the accumulation of Cs-134 in the seeds of the different cultivars but it reached up to 30 % for the leaves. The greatest value of the transfer factor in all the plants' tissues was expressed

in cultivar Rakita. The lowest level of accumulation of Cs-134 per unit of epigeous plant tissue was registered in cultivar TC-210 with transfer factor in the seeds, stem and leaves 0.021; 0.026; 0.076, respectively.

The results from the analysis of the same cultivars triticale raised on soil dystric planosol are shown on Fig. 2. They show more intensive uptake of the radio Cs in comparison with those raised on soil luvic phaeozem. This is due to the specific physical and chemical characteristics of the dystric planosol soil. It has a lower capacity of absorption and therefore transfers greater quantities of Cs to the plant. The impact of the humus and pH level of the soil is similar. The mechanical composition of the soil is very important for the uptake of Cs-134, as well. The plants raised on dystric planosol soil acquire greatest accumulation of the radionuclide in the vegetative organs, mainly in the leaves. The comparison between the different cultivars with respect to the content of radio Cs in the leaves of the experimental plants shows differences up to 37 %, and in the stem about 22-28 %. Cultivar Rakita shows the highest level of accumulation. It has the highest transfer factor (0.399 for the seeds; 0.466 for the stems; 1.537 for the leaves). Cultivar TC-210 shows the lowest level of accumulation.

According to many research-workers the cultivar differences with respect to the accumulation of the radionuclide can be explained only with the genetic factors, determining the metabolism peculiarity, valid for all phases of the ontogenesis ([9]). The differences in the content of Cs-134 in the separate plant organs are connected with the peculiarities of the discrimination of this element during its movement in the plants and its redistribution during the ontogenesis period ([8]). The obtained results are in accordance with Guljakin's Judinceva's and other research-worker's statement ([4]), that in the movement of the radionuclides in the above-soil organs of the cereal crops there is observed a common regularity – their accumulation occurs mainly in the vegetative organs.

CONCLUSIONS

1.There are differences in the accumulation of Cs-134 in the plants depending on the soil type on which they were raised. It was determined that the uptake of the radionuclide from plants raised on dystric planosol soil was more intensive in comparison with those raised on luvic phaeozem soil.

2. The highest transfer factor was detected in the leaf tissue of the studied cultivars for the two soil types, and the lowest - in the seeds.

3. The highest level of accumulation of the radiocesium was found in cultivar Rakita, and the lowest - in cultivar TC-210, for the two soil types.

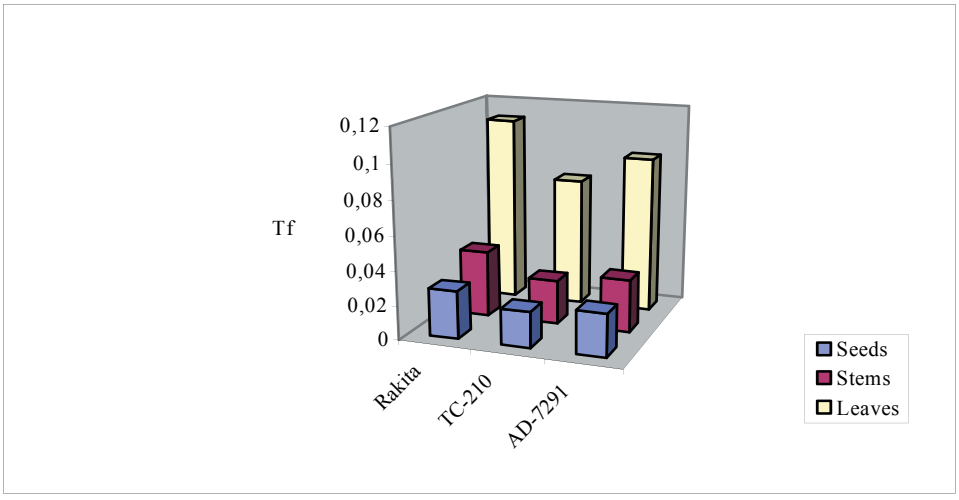

Figure 1: Accumulation of Cs-134 in different cultivars of triticale, raised on luvic phaeozem soil.

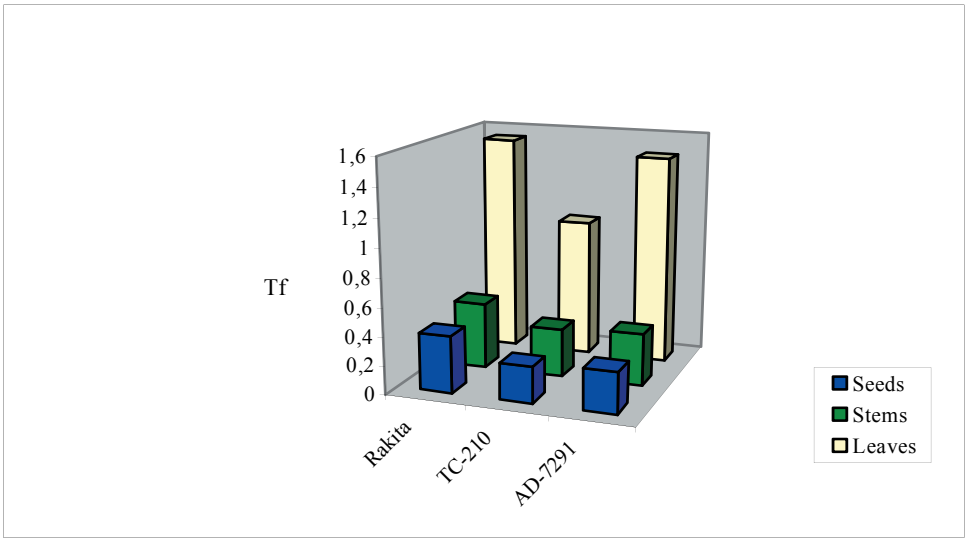

Figure 2: Accumulation of Cs-134 in different cultivars of triticale, raised on distric phanosol soil.

Table 1: Agrochemical characteristics of the studied soils.

Soil type	pH KCl	Humus %	Ca meqv/ 100g soil exchange	K_2O mg/100g soil	Sorption capacity $T_{8,2}$ meqv/100g soil
Luvic phaeozem	5,20	3,55	23,99	28,19	33,70
Dystric planosol	3,82	2,72	9,27	20,00	23,10

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