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INFLUENCE OF FOLIAR FEEDING OF SPRING WHEAT BY ZINC SOLUTION ON THE TRANSITION OF RADIO CESIUM FROM SOIL TO PLANTS

The importance of the production of agricultural products with a minimum content of radioactive substances is the main feature of farming on radiation contaminated territories. It can be achieved by creating conditions to minimize the radionuclide transfer from soil to plants. To reduce contamination of cropproducts it is important to apply those agrotechnical and agrochemical measures of agricultural practice that do not require significant changes in the existing technologies of growing crops.

Microelements play certain role in reducing radionuclides transfer to plants. It was established that the effect of microelementsis especially important in those soils where the content of microelements is low. Soils of Ukrainian Polissia, which have suffered from contamination by radioactive substances as a result of the Chernobyl accident, have mentioned above characteristics.

The role of microelements is not limited only by their interaction with radionuclides or macroelements. They can alsoinfluenceon the permeability of cell membranes for radionuclides with certain ionic radius, charge, as well as the geometry of coordination and electronic configuration [1].

Research on the effect of foliar feeding by solution of zinc on ^{137}Cs accumulation in spring wheat "Struna Myronivska" was conducted during 2014-2015 on the fields of the village Bazar, Zhytomyr region and in radioecology laboratory of Zhytomyr State Technological University. The soils of research areas are sod-podzol (gleyey, sandy-loam on moraine and water-glacial sediments with moraine underlay).

To determine the effect of foliar feeding by solution of zinc in different phases of growth and development on ^{137}Cs accumulation by spring wheat, sulfate salts of zinc (ZnSO4) at a concentration of 0.05% off mass ratio were used. Repeated experiments are quadruple. Consumption ofzinc solution foranindividual researchplot of 3.5 x 2 m^2 amounted to 0.28 liters, and for the total plot of 14 x 10 m^2 amounted to 5.6 liters. The scheme of the experiment included control and four experimental choices: 1 - control (without spraying); 2 - spraying crops in the tillering phase; 3 - spraying in the phase of stem extension; 4 - spraying in the phase of flowering; 5 - spraying in the phase of fruit development.

Sampling of soil and plants is carried out in the phase of fruit development.

Samples of soil. Two soil samples from each individual plotwere chosen and formed a combined sample. Soil sampling was performed using a soil drill with a diameter of 5.7 cm and a height of 15 cm. Soil samples were dried to constant weight, sieved by a sieve of 2 mm diameter to removeplant roots from samples and to makethemixture homogeneous. After that, the mixture was placed in geometry of 60 ml and weighed. ^{137}Cs specific activity was measured in these soil samples using the system of scintillation spectrometry GDM 20. Measurement error did not exceed 5%. On average, the procedure of samples measurement lasted for 20 minutes.

Samples of grain wheat. Samples of grain were selected by cutting them at the height of 5 – 7 cm at two points on each of the individual plots using a frameof 0.5 x 0.5 m^2. Selected samples were combined to forma combined sample. Plants were threshed by hand and grain, purified from straw remains, was weighed and placed in 35 ml volume geometry. Also, thecalculation of yield per 1 hectare of crop was done. On average, the procedure of wheat samples measurement lasted for 6 - 7 hours due to their low specific activity.

Samples of straw. After threshing of wheat, straw samples were weighed and crushed to achieve a homogenized state.The resulting material was placed in 60 ml volume geometry andweighed again. On average, the procedure of straw samples measurement lasted for 6 - 7 hours due to their low specific activity.

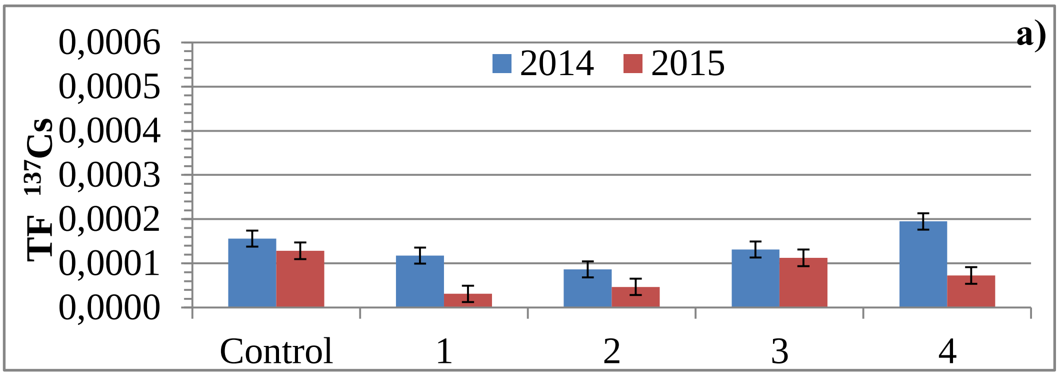
^{137}Cs specific activity of grain and straw samples of spring wheat was also measured by detector GDM 20. To evaluateradionuclide transfer from soil to grain and straw, the ratio (transfer factors, TF): ^{137}Cs in grain or straw, Bq/kg / ^{137}Cs in soil, Bq/m^2, m^2/(kg^{-1}) was used.

Specific activity in grain and straw samples changed over the years in different phases of spring wheat growth and development. On average, the specific activity in the grain of control variant ranged from 16 to 27.3 Bq/kg during 2 years. When spraying plants in the phase of tillering, the radionuclide specific activity in grain was about 2 times lower compared to the control indicator. Similarly, when spraying in the phase ofstem extension, the specific activity of grain was by 58% lower compared to the control indicator. Specific activity of grain with foliar feeding byzinc solution in the phase of flowering did not differ from control indicator. Spraying plants in the final phase of grain fruit development did not affectthe level of specific activity of grain compared to the control variant.

Cesium specific activity in straw ranged, on average, from minimally detected level to ≈ 100 Bq/kg in the control variant during 2 years. The levels of theradionuclide specific activity in straw appeared to be the lowest at spraying plants in the phase of fruit development in comparison with the control variant.

^{137}Cs transfer factor from soil intograin and straw of spring wheat at its foliar feeding by solution of zinc for 2 years of research are presented in Figure 1.

Thus, as seen in figure, ^{137}Cs transfer factors for grain and straw, when spraying plants of spring wheat with a solution of zinc in 2015, were significantly lower compared to 2014 year due to arid conditions prevailing during the growing season in 2015. On average, for 2 years of investigation, the coefficients of transfer factor from soil to grain on the control variant fluctuated in the range from 0.00013 to 0.00016, while to straw - from 0.00011 to 0.00053. When spraying plants in the phase of tillering, TF from soil to grain, on average for 2 years, was by ≈ 50% lower compared to control indicator (Fig. 1). A similar efficiency of foliar feeding of wheat plants with a solution of zinc occurred at spraying in the phase of stem extension.TF of the radionuclide from soil to grain, for 2 years of investigation, turned out to be approximately 2 times lower in comparison with the control indicator. Spraying wheat plants in the phase of flowering proved ineffective – transfer factor of radionuclide from soil to grain practically did not change compared to the control variant. When spraying plants in the phase of fruit development, TF values of radio cesium from soil to grain, for 2 years of investigation, were the same with control variant values (Fig. 1).



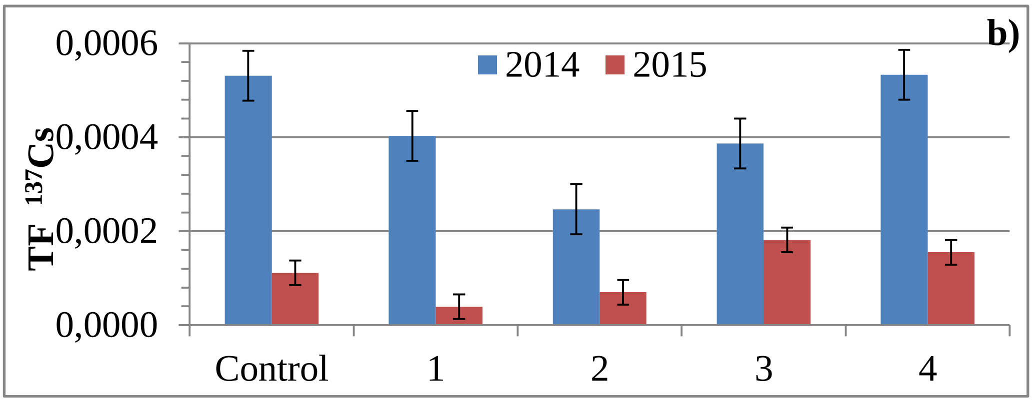


Fig. 1 ^{137}Cs transfer factors in grain (a) and straw (b) samples of spring wheat (2014 – 2015). The phases of plant growth and development at the time of spraying 1 - tillering phase; 2 - phase of stem extension; 3 – phase of flowering; 4 - phase of fruit development. n = 4.

A similar effect of foliar feeding of wheat plants with a solution of zinc on the value of transfer factor from soil to plant was observed in straw. Thus, the most effective was spraying wheat in tillering phase and stem extension. When spraying wheat in the tillering phase, the straw received the radionuclide by almost half (≈ 45%) less than in control variant, while spraying in the phase of stem extension by 50% compared with the control value. Feeding wheat plants with a solution of zinc in the second half of the growing season proved ineffective; transfer factors of radioactive cesium from soil in straw, on average for 2 years of investigation, were at values of control variant.

Thus, according to the received results, the first half of the growing season, namely the phase of tillering and stem extension, is the best time for foliar feeding of spring wheat by solution of zinc to reduce radio cesium transfer from soil to grain and straw when growing on sod-podzol soils. This technique provides a two-fold reduction of radionuclide transfer from soil both in grain and straw.

REFERENCES

1. Гудков І.М., Вінічук М.М. Сільськогосподарська радіобіологія: Навч. посіб. для аграр. вищ. навчальних закл. – Житомир: ДАУ, 2003. – 314 – 315 с.