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Studies of the Dynamics of Water Absorption in Soils with Different Types Using Nuclear-Physical Methods

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Abstract— *The article presents the results of experimental studies of the dynamics of water absorption in the active layer of the soil, with different types, using nuclear physics methods and measuring instruments. In laboratory conditions, experiments were conducted to study the dynamics of water absorption with stable and radioactive isotopes. The obtained data on the distribution of water in different types of soil*.

Keywords— *Soils with different types, nuclear-physical methods, resource-saving crops, radioactive isotopes*.

I. Introduction

The creation of efficient and resource-saving agricultural production in the territories of Central Asia, in particular Uzbekistan, has become a demand of the time. The decision of the country's food programs in particular depends on the strategy of using natural resources. Scientists and experts in the field of the agricultural industry of the Republic have achieved some success. Innovative technologies of growing crops and scientific achievements of seed breeding are being introduced. The problems of efficient use of water resources of the country is still an unsolved problem at the present time, the consequences affect the productivity and productivity of the industry every year. In this way, the reasonable and efficient use of available natural resources, in particular water resources, is the main task in the production of agricultural products.

To catastrophe and the Aral Sea, which led in recent decades, to such conditions that the tasks of a scientifically based approach and the development of optimal and effective methods of cultivating the soil have been set before the specialists of the agrarian industry, by means of a realistic assessment of the existing soil-water-climate system in the region.

In chewy mi and a specialists Laboratory of Ecology and Biotechnology, Institute of Nuclear Physics, Academy of Sciences of the Republic of Uzbekistan and the Department "Exploitation of hydro reclamation systems" Tashkent Institute of Irrigation and Agricultural Mechanization Engineers co-lead GSI research on the study of patterns of water distribution in the active layer of soil at using existing irrigation methods (traditional and drip irrigation) using nuclear-physical methods of elemental analysis. In this work, we used nuclear-physical methods for analyzing the composition of a substance, in particular, the neutron activation method of analysis and gamma- spectrometric instruments based on semiconductor and scintillation detectors. As a neutron source for the irradiation of soil samples from experimental fields, a unique WWR-SM nuclear reactor of the Institute of Nuclear Physics of the Academy of Sciences of the Republic of Uzbekistan was used.

All chemical elements that we encounter in nature are a mixture of several isotopes. Isotopes are divided into stable and radioactive. The use of isotopes reveals extremely wide possibilities for researchers working in various fields of science, including its agricultural branches.

A brief overview of the simplest studies conducted with the help of radioactive isotopes contained in the work ah [1-3]. The author reflects discoveries in the field of plant physiology and agro chemistry, which were made with the help of radioactive isotopes of chemical elements that are most convenient for research purposes. These include the determination of the rate of movement of nutrients through the vessels of plants, the rate of absorption by their roots from the soil, and the influence of environmental conditions on these processes. The issues of the introduction of phosphate and nitrogen fertilizers, as well as the best terms of their application are considered. Found some coverage of photosynthesis.

To study the processes of plant nutrition in order to claim I Acquiring high crop yields, isopolls ovens radioisotopes most important nutrients: phosphorus (^{32}P), carbon (^{14}C), calcium (^{45}Ca), potassium (K^{40}). The physical characteristics of these radioisotopes (a sufficiently long half-life, convenient for recording the type and energy of radiation) make it possible to monitor their arrival from the soil and fertilizers in various crops, to determine the best terms and forms of fertilizer application.

To ensure the normal functioning of biological organisms, trace elements are necessary, which are mainly consumed by plants from the soil. The lack of trace elements limits the growth and development of plants, causes disease. The role of microelements (cobalt, zinc) in the metabolism was clarified using the radioactive labeling method (^{60}Co, ^{65}Zn) [5]. The methods of work with the use of active indicators for the sake of active indicators are described in [4, 6, 7]. Radioisotopes are used in biological, medical research, mining and metallurgical, agricultural and other branches of science, engineering and industry. Radioactive isotopes and nuclear-physical measurement methods are also of great interest in the

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study of the properties of soil and water resources as a tool and method for research.

Selection and justification of nuclear-physical parameters of radioactive isotopes for use in laboratory studies.

The nuclear-physical parameters of isotopes include atomic mass, type of radioactivity (alpha, beta, gamma and other types of radioactivity), half-life, spectrum and nature of radiation, energy of an analytical signal (peaks in the spectrum). These parameters should be studied in order to select suitable ones among those obtained on the basis of a nuclear reactor of the type VVR-SM of the Institute of Nuclear Physics, Uzbek Academy of Sciences. Isotopes for experimental research on this topic.

The most important type of radioactive radiation is gamma radiation, in which the composition of the atomic nucleus does not change, but only the excess energy of the atomic nucleus is emitted. By its nature, gamma radiation is electromagnetic radiation that occurs during the transition of atomic nuclei from excited to a lower energy state. Among nuclear radiation, gamma radiation is distinguished by its high penetrating power through substances. Radioactive isotopes can emit gamma radiation in a large energy range, ranging from a few eV to 10 000 000 eV. Radioactive isotopes can be obtained on an atomic reactor, by exposure to neutron flux of almost all chemical elements in the periodic system.

The gamma spectra of each atomic nucleus are characteristic and may be identified. The location of the analytical peak, gamma radiation relative to the reference samples is usually determined by the concentration of the desired element.

Copper is determined by the reaction $^{63}Cu\ (n, \gamma)\ ^{64}Cu$. The half-life of a ^{64}Cu radioactive isotope is $T_{1/2}$= 12.7 hours. The energy of the analytical γ line is equal to E_{γ}= 511 keV and 1345 keV. The detection limit of copper according to the method is: 0.1 mg / g.

The production of radioactive isotopes of sodium and copper was carried out by irradiating the natural stable isotopes sodium-23 and copper-63 in the thermal neutron flux of an atomic-type reactor VVR-SM, INP AN R Uz. The resulting radioactive isotopes are then diluted with water to the desired concentration.

And the natural stable isotope sodium-23, when irradiated in a stream of thermal neutrons, is converted into a radioactive isotope according to the following nuclear reaction: $^{23}Na\ (n, \gamma)\ ^{24}Na$. The radioactive isotope ^{24}Na has a half-life T = 15h and emits intense gamma radiation with an energy of E = 1368.6 keV. These gamma-rays are the main analytical signals for locating an aqueous solution of radioactive isotopes and calculating the amount of absorbed aqueous solution in the soil.

Under laboratory conditions, studies were conducted by sampling soil with different degrees of salinity and carrying out neutron activation analysis of the macro- and microelement composition of the samples. Then stable isotopes were added to the soil. ^{63}C u, ^{23}Na in the form of an aqueous solution. After watering after 5 hours, a soil sample was taken from the experimental area for elemental analysis. They took 6 samples of 250 grams each. Following the procedure of preparation for neutron activation analysis of soil samples were dried to constant weight in an oven at a temperature of 60°C, milled, averaged over the volume of each sample and the samples are selected to 1 gram. After that, the samples were placed in a plastic bag, which was then sealed and turned into aluminum foil and placed in a special container (capsule) of aluminum for irradiation on the thermal neutron flux of the atomic reactor.

The gamma activity of the irradiated samples was measured on a Canberra gamma spectrometer (USA), consisting of a HPGeGC 1518 germanium detector (relative efficiency -15%, resolution for the ^{60}Co 1332 keV line - 1.8 keV), digital analyzer DSA 1000 and personal computer with software package Genie 2000 for the collection and processing of gamma spectra.

The detection limit of copper according to the method is: 0.1 mg/g. The copper concentration in soil samples on average between 0 and 3 mg/g, - 0 to 8 mg/g. The limit of sodium determination is 0.06 mg/g. The concentration of sodium in real soils of Uzbekistan, depending on the degree of salinization, ranges from 0, 8% to 1.9%.

Taking into account the relatively low limit of the determination of copper content, and the difficulty of subtracting background values that interfere with the determination of copper in the 514 keV line, we lost the addition of an aqueous solution of copper sulphate, the copper concentration of the experimental area was increased about 5 times. According to the content of these two isotopes, we studied the distribution of water in the active layer of the soil (at a depth of 0–50 cm).

The main features of the soil of the experimental site are heavy soil, brown in color, the specific weight of which is 2.65-2.85g/cu. The maximum soil moisture capacity is 0.9 g / cm 3. The soil contains small grains of pebbles, fine-grained strata and they are characterized by a low degree of salinity. The degree of soil acidity is low (pH=6.5). In the experiments, the soil type was conventionally divided into 3 classes: Type - A - this is untreated soil, type - B - soil, poor machining, type –B - soil with high-quality machining and fine-grained soil.

As a result of experimental studies using the neutron activation method of analyzing the elemental composition in soil samples with low salinity, the data obtained are given in Table I.

Also, according to neutron activation analysis in soil samples with high salinity, experimental data were obtained, which are given in Table II.

From the experimental data obtained in Tables I and II, it can be seen that the distribution of water in the active soil layer with different degrees of salinity is very different. In soils with less salinity, water penetrates more into the depth of 30-40 cm than in soils with high salinity.

TABLE I. The copper content introduced into the soil with an aqueous solution. (Measurement of copper concentration, mg/g.)

Depth	0-5cm	6-10cm	11-15cm	16-20cm	21-25cm	26-30cm	31-35cm	36-40cm
1.Type-A	0.079	0.054	0.023	0.015	0,007	0,002	0,000	0,000
Tip B	0.071	0.053	0.032	0.022	0,009	0,003	0,000	0,000
Tip-B	0.056	0.050	0.047	0.036	0.031	0.025	0.011	0,007
2.Type-A	0.085	0.064	0.023	0,009	0,004	0,000	0,000	0,000
Tip B	0.082	0.059	0.022	0,010	0,003	0,000	0,000	0,000
Tip-B	0.079	0.057	0.021	0.011	0,003	0,000	0,000	0,000
3.Type-A	0.060	0.056	0.042	0.034	0.031	0,018	0,010	0,003
Tip B	0.061	0.055	0.041	0.035	0.030	0.024	0.012	0,004
Tip-B	0.056	0.053	0.048	0.041	0.034	0.023	0.011	0,005

TABLE II. The copper content introduced into the soil with an aqueous solution. (Measurement of copper concentration, mg / g.)

Depth	0-5cm	6-10cm	11-15cm	16-20cm	21-25cm	26-30cm	31-35cm	36-40cm
1.Type-A	0.085	0.057	0.021	0.012	0,004	0,000	0,000	0,000
Tip B	0.073	0.055	0.030	0.024	0.011	0,000	0,000	0,000
Tip-B	0.049	0.045	0.042	0.026	0.012	0,002	0,000	0,000
2.Type-A	0.084	0.067	0.043	0,019	0,006	0,000	0,000	0,000
Tip B	0.088	0.054	0.029	0.013	0,004	0,000	0,000	0,000
Tip-B	0.077	0.053	0.026	0,019	0,008	0,004	0,000	0,000
3.Type-A	0.065	0.054	0.041	0.024	0.011	0.02	0,000	0,000
Tip B	0.069	0.051	0.032	0.015	0,007	0.02	0,000	0,000
Tip-B	0.068	0.051	0.042	0.031	0.014	0.03	0,000	0,000

The results of measurements with a radioisotope of sodium, in samples of mechanically untreated soil, are shown in Table III.

TABLE III. The results of the study of the dynamics of the distribution of water and aqueous solutions in the active layer of mechanically untreated soil.

	The depth of the soil layer, cm							
	0 - 5	6-10	11-15	16-20	21-25	26-30	31-35	36-40
Analyte-cal signal regis-ment for10min measurement (imp.)	1560	1220	610	160	75	ten	0	0
	1620	1310	1050	830	530	220	85	1 7
	1550	1260	780	560	230	65	24	four
	1640	1180	840	470	210	50	15	2
	1690	1210	750	380	120	65	22	6
	1590	1230	860	320	115	35	ten	one
	1610	1260	735	460	326	178	95	2
	1560	1280	675	125	56	four	0	0

The results of measurements with a radioisotope of sodium, in samples of sandy soil and mechanically treated soil, are shown in Table IV.

TABLE IV. The results of experiments studying e NIJ water distribution and dynamics of aqueous solutions in the sandy soil and in the soil quality machining

	The depth of the soil layer, cm							
	0 - 5	6-10	11-15	16-20	21-25	26-30	31-35	36-40
Analyze-call signal regiment for10min measurement, (imp.)	1 4 20	1 321	1212	785	367	156	5 3	1 3
	14 60	1 328	1125	776	324	135	39	2 1
	14 50	13 12	1235	665	353	167	50	1 6
	14 60	1 379	1278	735	347	152	34	1 5
	15 10	1 3 04	1105	756	289	131	39	1 3
	15 0 0	1 3 08	1074	687	321	123	3 9	1 2
	1490	12 70	1086	675	314	127	38	9
	146 0	1 288	1021	706	311	120	54	9

As can be seen from table III and IV, the dynamics of water distribution in soils with different types of mechanical processing and the degree of salinity are very different. The better the soil is treated, the more deeply and evenly water is absorbed. Also, the less soil salinity, the smoothly penetrates into the depth of the soil to a distance of 30-40 cm.

Figure 1 shows the dynamics of water absorption in the active soil layer in the experimental areas, depending on the type of soil and the degree soil salinity.

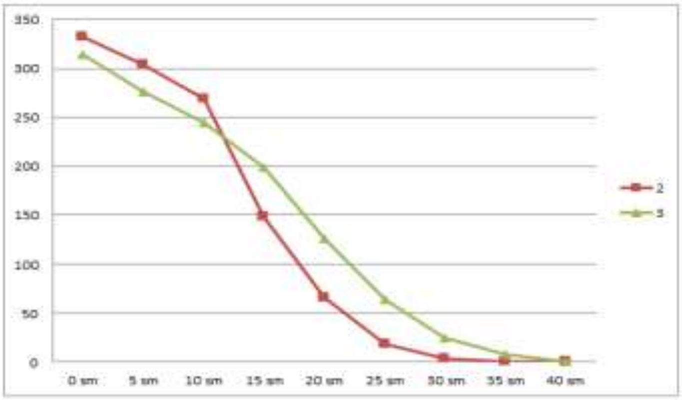

Fig. 1. Dynamics of water absorption in the active soil layer experimental plots depending on the type of soil and degrees soil salinity

As can be seen from the figure 1 the dynamics of water absorption in the active layer of soil with different degrees of salinity is significantly different from each other.

II. CONCLUSIONS

And the patterns of distribution in the odes in the active layer of the soil, of different types and degrees of salinity, are studied with the use of nuclear-physical methods and measuring instruments. In vitro claim rovedeny experiments to study dynamics of water absorption with the stable and radioactive isotopes. The dynamics of water distribution is revealed at different degrees of soil salinity. The obtained results allow us to conclude that this method can be used to find effective ways to use water resources in saline-prone soils in water-deficient regions of Uzbekistan.

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References

[1] Fokin A.D., Lurie A.A., Torshin S.P. “Agricultural Radiology” St. Petersburg: “Lan”, 20 11, 416s.

[2] Molchanova I.V., Kulikova N.V. Radioactive isotopes in the soil-plant system. M.: Atomizdat, 1972 g of. 86c.

[3] Blum B.G. The balance of isotope-labeled ^{15}N nitrate, ammonium and amide nitrogen fertilizers in field crop rotations // Cycle and nitrogen balance in the soil-fertilizer-plant-water system. - M.: Science, 1979. - P.65-72.

[4] Efimov V.N., Osipov A.I., Chesnokova E.F. The use of soil nitrogen and fertilization by barley plants on sod-podzolic sandy soils of different degrees of cultivation // Agrochemistry, 1985. No. 7 P.3-7.

[5] Kuzyakov Ya.V. Isotopic-indicator studies of carbon translocation by plants from atmosphere to soil: (Literature review) / Pedology. 2001. No. 1. S. 36-51.

[6] Annenkov B.N., Yudintseva E.V. "Fundamentals of agricultural radiology" M.: Agropromizdat, 1991. 286 p.

[7] Rachinsky V.V. Fundamentals courses nuclear techniques in agriculture. M.: Atomizdat, 1974. 391p.

[8] B. Mirzaev, F.M. Mamatov, the nature of the interaction of flat blade cutters with cutting materials, «Water management-state and prospects of development» Collected articles of young scientists, Part 1, RIVNE, 2010. 77-79 pages

[9] B. Mirzaev, I. Avazov, Sh. Mardonov, Perspective directions of development of new soil cultivation machines againt soil erosion printed «Water management-state and prospects of development» collected articles of young scientists, part 1, rivne, 2010. 18-20 pages

[10] B. Mirzaev, F.M. Mamatov, Soil protection and moisture saving technologies and tools for tillage, Euroopean Applied Sciences. 2013, -№9. -P.115-117.

[11] Durmanov, A. (2018). Cooperation as a basis for increasing the economic efficiency in protected cultivation of vegetables. Bulletin of Science and Practice, 4(8), 113-122.

[12] Durmanov, A., & Umarov, S. (2018). Economic-mathematical modeling of optimization production of agricultural production. Asia Pacific Journal of Research in Business Management, 9(6), 10-21.

[13] Durmanov, A. Sh., & Yakhyaev, M. M. (2017). Measures to increase the volume of exports of fruit and vegetables. Herald of the Caspian, (4).

[14] Ibragimov, A. G., & Durmanov, A. S. (2017). Issues of the development of competitiveness and the prospects of specialization in rice farms. SAARJ Journal on Banking & Insurance Research, 6(5), 14-19. doi:10.5958/2319-1422.2017.00021.2.

[15] Durmanov, A. Sh., & Khidirova, M. H. (2017). Measures to increase the volume of exports of fruit and vegetable products. Economics, (9), 30-34. (in Russian).

[16] Durmanov, A. Sh. (2018). Foreign experience the organizational-economic mechanisms of improving the activities of greenhouse farms. Economics and Finance (7), 20-28.

[17] DURMANOV, Akmal Shaimardanovich; TILLAEV, Alisher Xasanovich; ISMAYILOVA, Suluxan Sarsenbayevna; DJAMALOVA, Xulkar Sayorovna & MURODOV, Sherzodbek Murod ogli. (2019) Economic-mathematical modeling of optimal level costs in the greenhouse vegetables in Uzbekistan. Revista ESPACIOS. 40 (Nº 10), (20) http://www.revistaespacios.com/a19v40n10/19401020.html