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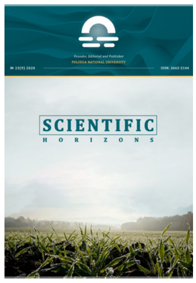

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Quality of Pea Seeds and Agroecological Condition of Soil When Using Structured Water

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Abstract. The widespread use of water in crop production and agriculture is due to a significant increase in yields during the watering of agricultural crops, as well as the transfer of pesticides and mineral fertilizers to plants and soil by water. One of the ways to improve the quality of water used in crop production is to structure it. An urgent task is to study the effect of structured water delivered to agricultural crops by watering or spraying on the yield, quality of the resulting products and agroecological condition of the soil. Field studies on pea crops were conducted at experimental sites of the Vinnytsia National Agrarian University, laboratory studies were conducted in accredited laboratories for monitoring the quality, safety of feed and raw materials of the Institute of Feed Research and Agriculture of Podillya of the National Academy of Agrarian Sciences of Ukraine and the testing centre of the Vinnytsia branch of the state institution "Institute of Soil Protection of Ukraine". When watering peas with structured water, its yield increases by 42.3% compared to the version without water application and by 22.3% compared to the version with watering with plain water. Pea seeds when watered with structured water have a lower content of crude protein by 0.43 %, crude fat – by 0.09%, crude ash – by 0.63%, but a higher content of crude fibre by 0.11% and nitrogen-free extractives – by 0.99% compared to the version without water. The content of humus in the soil, when watered with structured water, was lower than in the version without water by 0.04%, lightly hydrolysed nitrogen – by 8.0%, mobile phosphorus – by 20.0%, exchangeable potassium – by 7.9%, the reaction of the soil solution – by 0.2 pH, hydrolytic acidity – by 21.7%, the concentration of mobile lead – by 18.4%. However, the concentration of mobile cadmium increased by 43.8% and soil moisture – by 4.3%. When comparing the indicators of the agroecological state of the soil, which was watered with structured and plain water, it was found that watering with structured water reduces the content of humus by 0.03%, lightly hydrolysed nitrogen – by 2.3%, mobile phosphorus – by 20%, exchange potassium – by 9.7%, hydrolytic acidity – by 7.7%, the reaction of the soil solution – by 0.3 pH, but increases the content of mobile lead by 10.9%, mobile cadmium – by 25.0% and increases the moisture content in the soil – by 2.7%

Keywords: grain, chemical composition, fertility, acidity, heavy metals, humidity

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INTRODUCTION

Water is widely used in crop production and agriculture, in particular, most pesticides and some fertilisers are applied through transportation by the aquatic environment. In the conditions of climate aridisation, the role of water in the watering and irrigation of crops is growing. It is a well-known fact that crop yields increase considerably when crops are watered. At the same time, it is not rational to fully use irrigation of agricultural crops by sprinkling due to the high material costs of restoring or creating an irrigation system and water needs. Therefore, a more promising method of irrigation is drip irrigation with economical use of water by bringing irrigation tapes to each row. This method of watering the crops is mainly used in vegetable growing and in limited areas [1].

Due to global warming, water shortages in crop production will become more and more acute every year, so the question of delivering water to plants in some form or other in the most sustainable way with special preparation and saturation with nutrients, growth regulators or pesticides will be extremely relevant. Among the methods of water treatment for use, structuring has recently become widespread, which implies the acquisition of a natural molecular structure by water. Among a significant number of methods of water structuring: freezing, cavitation, the use of ultrasound, magnetic radiation – a new method is information structuring by activating water. Unlike prolonged freezing, water structuring through activation occurs almost instantly. This is confirmed by studies of the laboratory of the company "Soyana" and experiments to assess the average motor ability of spirost (infusoria type). The method of structuring water by activation is based on the transmission of bioelectric information, or energy. Structuring occurs in the form of changes in the geometric structures of water crystal molecules. Changing the structure of water can change its physical and chemical characteristics and affect the growth and development of plants and the state of the soil in a completely different way [2].

Structured water is largely close to natural water in its characteristics. It is characterised by an ordered liquid crystal structure with the preservation of biological information. Structured water is more fluid with altered dielectric properties. These changes accelerate the processes of crystallisation, dissolution, adsorption and energy transfer. It is these characteristics that accelerate the course of biological processes in the cell [3].

Structured water is marked by an ordered cluster structure. Such water corresponds in structure to the water contained in the cells of organisms, so the processes of its assimilation proceed much faster. When this water enters plants, the protective functions of the cell increase, and a number of biochemical processes accelerate. Components of structured water – mineral salts, trace elements, gases, as well as temperature have a positive effect on living organisms [4].

In structured water, the rate of chemical reactions and crystallisation of solutes increases, adsorption processes intensify, coagulation of impurities and their precipitation improves. The structuring of water affects the behaviour of impurities contained in it, although the essence of these phenomena has not yet been precisely clarified. It is quite possible that the biological effect of structured water on the body is since the channels (pumps) of tissue cell membranes pass structured water molecules at an increased rate, because the regular structure of water resembles the regular structure of the cell membrane itself – highly structured organelles [5].

Clusters of water molecules are generally made up of many well-attracted molecules. This form of attraction allows toxins and pollutants to enter a cluster of water molecules. When these clusters of water pass through the cell membrane, many of them linger because they are too large or because of toxins that the plant is programmed to reject. Smaller of these chaotic clusters will enter the cell, and some carry toxins with them [6].

Structuring changes water molecules into very small clusters, each consisting of six symmetrically organised molecules. This cluster is called "biologically pure" because of its hexagonal structure and because toxins cannot move inside the cluster and easily enter the passages of plant and animal membranes. The result provides maximum, healthy hydration with less water. Structured water breaks down clusters of individual molecules, providing better hydration for humans, animals, and plants.

Water structurizers further break down minerals into small particles, making them more bioavailable to plant cells. This contributes to maximum hydration of healthy water with greater absorption of nutrients and leads to increased yields, better quality, earlier maturation, long-term storage and higher resistance of plants to harmful organisms. It also reduces the amount of water, fertilisers, and pesticides applied [7]. As structured water breaks down all minerals into smaller particles, the salt in the soil is broken down by the structured water, causing it to sink deeper into the soil away from the plant roots and be washed away. Decontamination occurs quickly throughout the season, creating much healthier plants, higher yields, and a better end product.

Today, there are no problems in obtaining structured water. There are compact and widely available water structurizers of both industrial and domestic nature. It is a nozzle that must be connected to the water supply pipes, which ensures the structuring of water. The only problem is calculating the required amount of liquid and the pressure supplied to the nozzle [8].

Purpose of the article is to determine the effectiveness of using structured water on pea crops and determine the most economical way to deliver such water to plants.

THEORETICAL OVERVIEW

According to H. Xu, R. Yang, J. Song agricultural water use is one of the largest in terms of water intake, so improving the efficiency of water use and quality by agricultural enterprises is an important way to reduce water scarcity. However, the expected saving of water by improving the efficiency of use and improving its quality may have the opposite result – insufficient increase in crop yields, deterioration of product quality and soil degradation [9].

According to S. Hou, H. Guo, K. Pan, J. Liu, and L. Zhang [10] studying the structure of water use in crop cultivation can become the basis for agricultural water management and a way to improve the efficiency of agricultural water use. The use of the necessary water resources for agricultural production, including chemical fertilisers, pesticides and the capacity of agricultural machinery, will inevitably provide indirect water for agricultural production.

N. Lu, K.M. Villa studied the influence of the use of contaminated water for agricultural needs on the health status of the population that ate products obtained by watering with such water [11]. J. Xie and X. Su investigated ways of rational water use in agriculture and crop production based on determining the costs of water delivery, preparation and application [12].

Since agriculture is a water-intensive industry, smart planning of agricultural water use is very important to ensure food security, therefore C. Li, T.T. Jiang, X.B. Luan, Y.L. Yin, P.T. Wu, Y.B. Wang, S.K. Sun analyse the contribution of four factors (water efficiency, productivity, crop structure, and scale of production) that affect the need for water for agriculture. Among these, water use efficiency and adjustments to the plantation structure have played a decisive role in helping to reduce water demand. Increasing productivity will increase water efficiency, thereby reducing the need for water for agriculture. However, large-scale expansion of production compensates for the role of increasing productivity and leads to an increase in the need for water for agriculture. To reduce the demand for water for agriculture, it would be important to improve water efficiency, improve irrigation technology, and not introduce more water resources to expand production [13].

The increased solubility of minerals enhanced microbiological properties and a long storage period after water treatment with structurizers can ensure not only an increase in the productivity of agricultural crops, but also change the chemical composition of products and the agroecological state of the soil, taking into account the significant saturation of crop rotations with mineral fertilisers and pesticides. The use of such water when spraying or watering crops by installing structurizers in the path of water movement can affect the overall state of the agroecosystem. However, very few such studies have been conducted, so there is little reliable data on the increase of agricultural crop productivity, changes in the chemical composition of products and the agroecological state of the soil when using structured water [14].

Therefore, an important direction for studying the effectiveness of using structured water in crop production is the method of treating agricultural crops with such water in different phases of their growth and development; the study of the optimal method of transporting structured water to plants by watering the soil or spraying crops.

MATERIALS AND METHODS

The research was conducted during 2019-2021 at the experimental sites of the Vinnytsia National Agrarian University within an open stationary greenhouse without covering with free precipitation and with centralised water supply. A small-plot experiment with an estimated plot area of 4 m^2 in 5 replications was established. The research programme was supposed to study the effect of using structured water on the yield of pea grain, its chemical composition and agroecological state of the soil. For this purpose, 5 variants were laid: 1 – without processing the pea crop with water (control); 2 – spraying the crop with structured water; 3 – watering the crop with structured water; 4 – water-ing the crop with plain water.

Processing of pea crops was carried out three times during the growing season: 1 – in the phase of three pea leaves; 2 – in the branching phase; 3 – in the budding phase. Spraying was carried out with a satchel sprayer with a water consumption of 200 l/ha. Watering was carried out by sprinkling with a sprinkler with an irrigation dose of 300 l/ha at a time. Water structuring was carried out by installing a structuring device on a centralised water supply pipe, followed by filling it with a sprayer or sprinkler. Spraying and watering was carried out in the evening in dry weather. The water structurizer "Ojas" was used [15].

The pea variety Album was sown. The yield of the variety is 2.96-3.78 t/ha. The duration of the growing season is about 82-84 days. Plant height – 63.6-72.5 cm. Resistance to lodging – 6.6-7.4 points. Resistance to shedding – 8.2-8.5 points. Drought resistance – 8.7-8.8 points. The suitability of the variety for mechanised harvesting – 7.8-8.8 points. Resistance to peronosporosis – 8.5-8.7 points. Resistance to root rot – 8.6-8.8 points. Resistance to ascochytosis – 7.8-8.5 points. Resistance to anthracnose – 8.3-8.4 points. The protein content – 24.4-24.8%. The height of attachment of the lower bean – 40-45 cm. Adapts to a variety of soil and climatic growing conditions. A highly suitable variety for mechanised harvesting [16].

Peas were sown manually in mid-April. Special measures to protect pea crops from pests and diseases were not carried out. One-time manual weeding was performed. The crop was harvested manually with grain weighing.

The following records and observations were carried out: grain yield was determined by weighing grain from the entire accounting area with conversion to 1 ha and to the standard humidity of seeds [10]; the chemical composition of grain in absolutely dry matter was determined in certified to confirm technical competence when conducting measurements in accordance with the requirements of DSTU ISO 10012:2005 "Measurement management system. Requirements for measurement processes and measuring equipment" of Laboratory for Monitoring the Quality, Safety of Feed and Raw Materials of the Institute of Feed Research and Agriculture of Podillya of NAAS: crude protein – by the Kjeldahl method, crude fat – by the Rushkovsky method for the amount of fat – free residue, crude fibre – by the Henneberg and Stoman method in the CSRIASA modification according to DSTU ISO 21415-2:2009, crude ash – by the dry ozylation method, nitrogen-free extractives – by the calculation method [17].

Agroecological analysis of the soil was carried out in the certified test centre of the Vinnytsia branch of the state institution "Institute of Soil Protection of Ukraine" in accordance with the requirements of DSTU ISO/IEC 17025:2017 according to the following indicators: humus – according to GOST 26213-91; lightly hydrolyzed nitrogen – by the Kornfield method according to DSTU 7863:2015; mobile phosphorus and exchangeable potassium – by the Chirikov method according to DSTU 4115:2002; the reaction of the soil solution PH – according to DSTU ISO 10390-2007; hydrolytic acidity – according to DSTU 7537-2014; mobile lead – according to DSTU 4770.9-0007; mobile cadmium – according to DSTU 4770.3-0007; moisture – by thermostatic-weight method [18; 19].

The soil on the experimental site of a stationary greenhouse is bulk, chernozem. Weather conditions during the years of research were typical for the forest-steppe zone of right-bank Ukraine with an uneven distribution of precipitation during the growing season of peas: prolonged droughts were replaced by intense precipitation, which limited the introduction of water to pea crops, especially in the late phases of its growth and development.

RESULTS AND DISCUSSION

The humus content in the soil of the control variant without water use was the highest and amounted to 4.44%. This was 0.01% more than in the variant of watering of pea crops with plain water, 0.02% more than in the variant of spraying pea crops with structured water, and 0.04% less than in the vari-ant of irrigation of pea crops with structured water (Table 1).

***Table 1**. Indicators of the agroecological state of the soil when processing pea crops using structured water (2019-2021), m±m*

Indicator name	Experiment options			
	Without water use (control)	Spraying with structured water	Watering with structured water	Watering with plain water
Humus, %	4.44±0.02	4.42±0.01	4.40±0.02	4.43±0.02
Lightly hydrolyzed nitrogen, mg/kg	137±3	120±2	126±3	129±3
Mobile phosphorus, mg/kg	600±8	480±12	480±12	600±8
Exchangeable potassium, mg/kg	252±2	222±3	232±2	257±3
Soil solution reaction, pH	6.9±0.1	7.0±0.1	6.7±0.2	7.0±0.1
Hydrolytic acidity, mg-equiv./100 g	0.46±0.03	0.37±0.02	0.36±0.02	0.39±0.02
Mobile lead, mg/kg	1.58±0.03	0.95±0.02	1.29±0.02	1.15±0.03
Mobile cadmium, mg/kg	0.09±0.01	0.13±0.01	0.16±0.01	0.12±0.01
Moisture, %	12.5±1.2	18.1±0.8	16.8±0.6	14.1±0.9

***Source**: authors' research*

The content of lightly hydrolysed nitrogen in the control soil without water application was 137 mg/kg and was the highest among all experimental variants. When watering pea crops with plain water, the content of lightly hydrolysed nitrogen in the soil decreased by 5.8%, when watering pea crops with structured water – by 8.0%, when spraying pea crops with structured water – by 12.4%.

The content of mobile phosphorus in the soil of the control variant without using water and the variant of watering of pea crops with plain water was the highest and amounted to 600 mg/kg. When using structured water on pea crops, the content of mobile phosphorus in the soil decreased by 20%.

The concentration of exchangeable potassium in the soil of the control variant without the use of water was 252 mg/kg. This was 1.9% less than when watering peas with plain water, but 7.9% more than when watering peas with structured water and 11.9% more than when spraying peas with structured water.

The reaction of the soil solution in the control without water application was 6.9 pH, which was 0.1 pH less than in the variants of spraying peas with structured water and watering peas with plain water, but 0.2 pH more than in watering peas with structured water.

The hydrolytic acidity of the soil in the control variant without water application was the highest and amounted to 0.46 mg-equiv./100 g. In the variant of watering peas with plain water, it was 15.2% less, on the option of spraying peas with structured water – by 19.6%, and on the option of watering peas with structured water – by 21.7% less.

The concentration of mobile forms of lead in the soil in the control variant without water use was the highest and amounted to 1.58 mg/kg. In the variant of watering pea crops with structured water, the concentration of mobile forms of lead decreased by 18.4%, in the variant of watering of pea crops with plain water – by 27.2%, and on the option of spraying pea crops with structured wa-ter – by 39.9% less.

The concentration of mobile cadmium forms in the control without water use was 0.09 mg/kg. This was 25% less than the variant of watering peas with plain water, 30.8% less than the option of spraying peas with structured water, and 43.8% less than the option of watering peas with structured water.

The soil moisture content of the control variant without water use was 12.5%, which was the lowest indicator among all the studied variants. When watering peas with plain water, soil moisture increased by 1.6%, when watering peas with structured water – by 4.3%, and when spraying peas with structured water – by 5.6%.

The analysis of the agroecological state of the soil when using structured water on pea crops showed that on the variants for using structured water, the lowest content of humus, lightly hydrolyzed nitrogen, mobile phosphorus, exchangeable potassium in the soil is observed, the lowest reaction of the soil solution pH, hydrolytic acidity and concentration of mobile forms of lead. This indicates that structured water in the soil translates nutrients and toxic substances into easily accessible forms for plants, they consume more of it, which affects the higher productivity of plants from variants for processing pea crops with structured water. Reducing the hydrolytic acidity of the soil on the use of structured water has a positive role, since more favourable conditions for plant growth and development are created. At the same time, options for treating pea crops with structured water had the highest content of mobile forms of cadmium and moisture in the soil. The increased moisture content in the soil determines the formation of favourable conditions for the moisture supply of the next crop in the crop rotation due to more economical use of structured water by the crop that was watered.

Comparison of agroecological indicators of the soil in variants for watering of pea crops with structured and plain water showed that the content of humus in the soil where pea crops were watered with structured water was 0.03% less, lightly hydrolysed nitrogen – by 2.3%, mobile phosphorus – by 20%, exchangeable potassium – by 9.7%, the reaction of the soil solution – by 0.3 pH less than when watering pea crops with plain water. However, the hydrolytic acidity of the soil decreases when using structured water on pea crops by 7.7% and the moisture content increases by 2.7%, which is a positive manifestation. The concentration of mobile forms of heavy metals in the soil also increases when watering peas with structured water, compared to watering peas with plain water: lead – by 10.9%, cadmium – by 25.0%.

Comparison of the effect on the soil of spraying and watering with structured water of pea crops revealed a tendency to reduce the humus content by 0.02%, increase the concentration of mobile forms of lead by 26.4%, cadmium – by 18.8%, decrease soil moisture by 7.2% and the reaction of soil solution – by 0.3 ph when watering pea crops with structured water. A negative manifestation of structured water spraying of pea crops, compared with their watering, was observed in relation to a decrease in the content of lightly hydrolysed nitrogen by 4.8%, exchangeable potassium – by 4.3%, but a positive change in the hydrolytic acidity of the soil, which decreased by 2.7%.

The obtained indicators confirm the thesis that structured water breaks down minerals contained in the soil into smaller particles, which facilitates their use by plants, including such toxic substances in the soil as heavy metals. This leads to a decrease in the concentration of minerals in the soil when watering crops with structured water.

The highest yield of pea grain was found in the variant of watering its crops with structured water – 5.79 t/ha, which was 42.3% more than in the control without water and 22.3% more than in the variant of watering peas with plain water. Spraying pea crops with structured water provides a seed yield of 4.65 t/ha, which was 28.2% more than in the control without water, but 19.7% less than when watering pea crops with structured water (Table 2).

***Table 2**. Pea grain yield depending on its processing with structured water (2019-2021), m±m*

Variants for processing pea crops	Seed yield, t/ha	± Before control, %
Without using water (control)	3.34±0.08	–
Spraying with structured water	4.65±0.05	+28.2
Watering with structured water	5.79±0.03	+42.3
Watering with plain water	4.50±0.05	+25.8

***Source**: authors' research*

Thus, it was found that at the site of watering pea crops with structured water, the yield of its seeds increases due to more intensive absorption of nutrients from the soil and, accordingly, impoverishment of the soil on them.

Analysis of the chemical composition of pea seeds in absolutely dry matter during the processing of its crops with structured water showed that the crude protein content was the highest in the control without the use of water – 26.41%. When spraying pea crops with structured water, the content of crude protein in its seeds, compared with the control without water application, decreased by 0.13%, when watering pea crops with plain water – by 0.43%, and when watering pea crops with structured water – by 1.2% (Table 3).

***Table 3**. Chemical composition of pea grain depending on its processing with structured water, % for absolutely dry matter (2019-2021), m±m*

Variants for processing pea crops	Crude protein	Crude fat	Crude fibre	Crude ash	Nitrogen-free extractives
Without using water (control)	26.41±0.34	3.42±0.04	11.13±0.09	4.76±0.13	54.27±1.56
Spraying with structured water	26.28±0.27	3.39±0.03	13.11±0.07	4.38±0.11	52.84±1.61
Watering with structured water	25.21±0.22	3.33±0.03	11.24±0.07	4.13±0.08	56.09±1.70
Watering with plain water	25.98±0.24	3.28±0.02	11.55±0.06	3.93±0.08	55.26±1.62

***Source**: authors' research*

The crude fat content of pea seeds in the control variant without water was 3.42%. In the variant of spraying peas with structured water, the fat content in their seeds decreased by 0.03% compared to the control without water, when watering peas with structured water – by 0.09% and in the variant of watering peas with plain water – by 0.14%.

The crude fibre content of pea seeds from the control variant without water was 11.13%. In the variant of watering peas with structured water, it increased by 0.11%, in the variant of watering peas with plain water – by 0.42% and in the variant of spraying peas with structured water – by 1.98%.

The crude ash content of pea seeds in the variant without water use was 4.76% and was the highest among all experimental variants. When spraying pea crops with structured water, the content of raw ash in its seeds, compared with the control without the use of water, decreased by 0.38%, when watering pea crops with structured water – by 0.63%, when watering pea crops with plain water – by 0.83%.

Nitrogen-free extractives in pea seeds from the control variant without the use of water contained 54.27%. This was 1.43% more than in the variant of spraying pea crops with structured water, but 0.99% less than in the variant of watering pea crops with plain water and 1.82% less than in the variant of watering pea crops with structured water.

The results of the research showed that watering pea crops with structured water, compared with watering its crops with plain water, reduces the content of crude protein in pea seeds by 0.77%, crude fibre – by 0.31%, but increases the content of crude fat by 0.05%, crude ash – by 0.2% and nitrogen-free extractives – by 0.83%.

Spraying pea crops with structured water, compared with watering its crops with structured water, increases the content of crude protein in pea seeds by 1.07%, crude fat – by 0.06%, crude fi-bre – by 1.87%, crude ash – by 0.25%, but reduces the content of nitrogen-free extractives by 3.25%.

Thus, watering pea crops with structured water contributes to obtaining the highest yield of its seeds, the highest content of nitrogen-free extractives in the seeds, but the lowest content of crude protein.

Irrigation with structured water of pea crops leads to an increase in its yield by 42.3% compared to the control variant without using water. This is due to more intensive use of nutrients from the soil, which causes a decrease in the humus content in the variant of watering pea crops with structured water by 0.04%, lightly hydrolysed nitrogen – by 8.0%, mobile phosphorus – by 20.0%, exchangeable potassium – by 7.9%, acidification of the reaction of the soil solution by 0.2 pH, compared with the control variant without water use. The increase in the yield of pea seeds from the variant of watering peas with structured water occurs against the background of a decrease in its seeds, compared with the control without water, the content of crude protein – by 1.2%, crude fat – by 0.09%, crude ash – by 0.63%, but an increase in the content of crude fibre by 0.11% and nitrogen-free extractives – by 1.82%.

The efficiency of using structured water irrigation of pea crops in comparison with conventional water is manifested in an increase in the yield of its seeds by 16.5%. This indicator was achieved by reducing the content of humus in the soil by 0.03%, lightly hydrolysed nitrogen – by 2.3%, mo-bile phosphorus – by 20.0%, exchangeable potassium – by 9.7%, and acidification of the soil solution reaction by 0.3 pH. However, with an increase in the yield of pea seeds, when watering its crops with structured water, the content of crude protein decreases by 0.77%, crude fat – by 0.05%, and crude fibre – by 0.31%.

CONCLUSIONS

Watering pea crops with structured water increases the yield of its seeds by 42.3% compared to the variant without using water and by 22.3% compared to watering with plain water. However, pea seeds reduce the content of crude protein by 0.43%, crude fat – by 0.09%, crude ash – by 0.63%, but increase the content of crude fibre by 0.11% and nitrogen-free extractives – by 0.99% compared to the option without water use. When watering peas with plain water, the content of crude protein in seeds from the structured water variant decreased by 0.77%, crude fibre – by 0.31%, but the content of crude fat increased by 0.05%, crude ash – by 0.2% and nitrogen-free extractives – by 0.83%.

When watering pea crops with structured water, changes in the agroecological state of the soil were observed compared to the variant without water use. In particular, the content of humus decreased by 0.04%, lightly hydrolysed nitrogen – by 8.0%, mobile phosphorus – by 20.0%, exchangeable potassium – by 7.9%, the reaction of soil solution – by 0.2 pH, hydrolytic acidity – by 21.7%, the concentration of mobile forms of lead – by 18.4% but increased the concentration of mobile forms of cadmium – by 43.8% and soil moisture – by 4.3%. Compared with the variant of watering pea crops with plain water, in the soil watered with structured water humus content was reduced by 0.03%, lightly hydrolysed nitrogen – by 2.3%, mobile phosphorus – by 20%, potassium exchange – by 9.7%, hydrolytic acidity – by 7.7%, the reaction of the soil solution – by 0.3 pH, but the concentration of mobile forms of lead increased by 10.9%, cadmium – by 25.0%, soil moisture content – by 2.7%.

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Якість насіння гороху та агроекологічний стан ґрунту при використанні структурованої води

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Анотація. Широке використання води у рослинництві та землеробстві зумовлене значним приростом урожаю під час поливу сільськогосподарських посівів, а також донесення до рослин і ґрунту пестицидів і мінеральних добрив водою. Одним із способів покращення якості води, що використовується у рослинництві є її структуризація. Актуальним завданням є вивчення впливу структуризованої води, що доноситься до посівів сільськогосподарських культур поливом або обприскуванням на урожайність, якість одержаної продукції та агроекологічний стан ґрунту. Польові дослідження на посівах гороху проводили на дослідних ділянках Вінницького національного аграрного університету, лабораторні – у акредитованих лабораторії моніторингу якості, безпеки кормів і сировини Інституту кормів та сільського господарства Поділля НААН та Випробувальному центрі Вінницької філії Державної установи «Інститут охорони грунтів України». При поливі гороху структурованою водою відбувається підвищення його урожайності на 42,3 % відносно варіанту без внесення води та на 22,3 % відносно варіанту з поливом звичайною водою. Насіння гороху при поливі структурованою водою має нижчий вміст сирого протеїну на 0,43 %, сирого жиру – на 0,09 %, сирої золи – на 0,63 %, проте вищий вміст сирої клітковини на 0,11 % і безазотових екстрактивних речовин – на 0,99 % відносно варіанту без внесення води. Вміст гумусу у ґрунті при поливі структурованою водою був нижчим, ніж на варіанті без внесення води на 0,04 %, азоту легкогідролізованого – на 8,0 %, фосфору рухомого – на 20,0 %, калію обмінного – на 7,9 %, реакція ґрунтового розчину – на 0,2 pH, гідролітична кислотність – на 21,7 %, концентрація рухомого свинцю – на 18,4 %. Проте зростала концентрація рухомого кадмію на 43,8 % і вологість ґрунту – на 4,3%. При порівнянні показників агроекологічного стану ґрунту, який поливали структурованою та звичайною водою, встановлено, що полив структурованою водою зменшує вміст гумусу на 0,03 %, легкогідролізованого азоту – на 2,3 %, рухомого фосфору – на 20 %, обмінного калію – на 9,7 %, гідролітичної кислотності – на 7,7 %, реакції ґрунтового розчину – на 0,3 pH, проте підвищується вміст рухомого свинцю на 10,9 %, рухомого кадмію – на 25,0 % та зростає вміст вологи у ґрунті – на 2,7 %

Ключові слова: зерно, хімічний склад, родючість, кислотність, важкі метали, вологість