сұр саздақ топырақтардың суғаруға дейін де және суғарылғаннан кейін де тұзданбаған топырақтар санатына жататындығын көрсетті.

Кілт сөздер: топырақ, тұздық режим, төгінді сулар, суғару, химиялық құрамы.

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ИЗМЕНЕНИЯ СОЛЕВОГО СОСТАВА СЕРОЗЕМНЫХ ПОЧВ ПРИ ПОЛИВЕ СТОЧНЫМИ ВОДАМИ В УСЛОВИЯХ ЮГО КАЗАХСТАНА

Аннотация

В статье приведены результаты полевых исследовании по выявлению влияния орошения сточными водами на солевой состав почвы. Солевой режим почвогрунтов изучался на всех опытных участках юга и юго-востока Казахстана ежегодно весной и осенью. Все лабораторные анализы обработаны на ЭВМ ЕС-4 программе института "Казгипроводхоз". Они дают основание сделать заключение что сероземные суглинистые почвы региона как до, так и после орошения относятся к категории незасоленных.

Ключевые слова: почва, солевой режим, сточные воды, полив, химический состав.

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STATE OF SOIL FERTILITY DURING WATERING WITH WASTEWATER IN THE SOUTH OF KAZAKHSTAN

Abstract

Article presents the results of our own laboratory, lysimetric and experimental studies using three types of wastewater for watering: depending on the type of soils: sierozem and meadow-bog soils. Also to assess the effectiveness of soil fertility, used the classification of I. Tyurin, M.M. Kononova, P. Machigin and Protasov, E. Arinushkina. In all experiments, as in watering with both pure water and wastewater, increase in humus was observed. This increase is more evident while watering with wastewater.

Keywords: watering, wastewater, soil, chemical composition, nutrients.

Introduction

Irrigation with wastewater creates favorable conditions for plant growth. However, non-compliance the irrigation regime, use of wastewater with a content of harmful contaminants above the maximum allowable concentration can lead to negative consequences. Irrigation with wastewater changes the physical state of the soil, the intensity of chemical and microbiological processes. Depending on the type of crop, the content of organic matter in the soil may decrease or increase. With the right choice of the method of irrigation, observance of the irrigation regime and the irrigation norm in combination with agrotechnical methods the negative impact of wastewater on the soil can be avoided.

During irrigation with wastewater, there is an accumulation of organic matter in the soil. Sewage contains organic soluble, suspended and colloidal substances that are retained in the soil. The increase in agricultural crop yields and especially the cultivation of perennial grasses are accompanied by an increase in the mass of their roots, which, when decomposed, partly turn into humus, which participates in the creation of a strong soil structure. In compliance with all conditions of irrigation with wastewater the accumulation of organic substances are ahead of the process of its destruction, and soil enriched with organic matter, soil fertility increases.

Microbiological processes in the soil are strongly influenced by the irrigation regime: irrigation rate, irrigation frequency, irrigation method, depth of the moistened layer.

n case of excessive watering, some of the air from the soil pores is displaced by water, the activity of anaerobic microorganisms is increased, the respiration of the roots is hampered due to a lack of oxygen and the plants are exposed to the toxic effect of the products of the anaerobic process (hydrogen sulphide, methane).

At optimum soil moisture increases the number of microorganisms, enhanced their activity and biological activity of the soil - a total index that takes into account the respiration of microorganisms, biochemical transformations in the soil, respiration of plant roots, etc. Numerically, the biological activity of the soil is expressed by the amount of carbon dioxide emitted from 1 square meter of the soil surface over a certain period of time. At the humidity wilting point of plants, the activity of microorganisms is weakened. 80-95% of humidity of the maximum hygroscopicity of the soil is minimal, when fungi and actinomycetes develop poorly. Aerobic bacteria-nitrifiers are inactive at humidity corresponding to double maximum hygroscopicity. The optimum moisture content of the soil for these microorganisms is about 60% of the total moisture capacity. When the humidity of the soil increases, their activity decreases. The process of nitrification of nitrogen in the soil slows down while too rare waterings and frequent overmoistening of the soil. Great influence has the watering on the activity of nodule bacteria. At lack of moisture nodules on the roots of leguminous plants are almost not formed, during irrigation this process proceeds normally and nitrogen nutrition of plants improves.

Materials and methods

Numerous works of domestic and foreign scientists show that many factors influence the soil qualitatively and quantitatively. The main ones are: water composition, irrigation regime, mechanical composition and genetic characteristics of the soil. However, the nature of the impact of irrigation by wastewater of different compositions is still very poorly studied and requires an urgent and in-depth study. In this paper, we present the materials of our own laboratory, lysimetric and experimental studies using three types of waste water: depending on the type of soils: sierozem and meadow-bog soils.

Analyzing numerous chemical data on the content of nutrients in the soil of experimental sites, it should be noted some features in the redistribution of these elements in the soil profile during wastewater irrigation. To assess the effectiveness of soil fertility, we used the classification of I. Tyurin, M.M. Kononov, P. Machigin and Protasov, E.V. Arinushkina.

Results and discussion

Medium-loamy soils of the Zhambyl region at six years of watering with household wastewater with an insignificant mixture with production water were not exposed significant changes.

According to the content of mobile forms of phosphorus and potassium, the soil becomes medium-ensured and highly ensured. The dynamics of nitrogen content in the soil is significantly affected by the crop rotation. In the area where alfalfa was intensively cultivated, the nitrogen content remained at the same level, and where sugar beet and barley alternated the nitrogen and total phosphorus content decreased. Similar can be noted for the South-Kazakhstan region. The meadow-bog soils of the Kyzylorda region also improved in the content of mobile forms of nitrogen and phosphorus during wastewater irrigation. Gross nitrogen with 0,098% decreased to 0,079%, and gross phosphorus from 0,11% to 0,09%.

Carrying out of summer and winter irrigation mixed with wastewater at farm "Burundai" in Almaty region helped the transition of soil from a very low ensured by nitrogen compounds to the hydrolyzed low ensured.

In all experiments, as in the case of irrigation with clean and wastewater, an increase in humus is noted. This increase during watering with wastewater appears more. But the intensive cultivation of barley at the farm «Tastoba» in Zhambyl region led to the unification of the soil with humus.

On the loamy light gray soils of the farm "Iliskiy" in Almaty region, under the crops of alfalfa, Jerusalem artichoke, sunflower marsh, an increase in nitrogen is observed, which indicates their ability to assimilate nitrogen with nodule bacteria. And here, also, under the crops of the studied cultures, there was some increase in mobile forms of phosphorus and potassium, although their incomes with wastewater are insignificant. This is the result of their mobilization from the gross reserves of the soil. Therefore, in order not to reduce the fertility of the soil, it is necessary to systematically introduce phosphorus-potassium fertilizers.

An important indicator characterizing the process of soil wastewater treatment, we studied in the pilot sites in the farm "Iliskiy". The obtained data (Table 1) show that sprinkling irrigation creates better conditions for the nitrifying ability of the soil than the surface one. This is due to the fact that surface watering to some extent disturbs the aeration of the soil, which is favorable for the accumulation of ammonia nitrogen.

With surface watering, the greatest accumulation of nitrates is observed under crops of non-traditional crops - amaranth, mallow, sunflower.

An important effect on soil fertility is provided by livestock wastewater (Table 2).

Table 1. Changes in nitrate, ammonia nitrogen in a meter layer of soil in the experimental sections of the farm «Iliskiy» in Almaty region under various wastewater irrigation methods, mg/ kg

Indicators	Original content	Methods of watering (6 years of irrigation)		
		sprinkling irrigation	furrow irrigation	sprinkler watering
Nitrates	3,6	22,3	3,4	21,2
Ammonia nitrogen	9,8	5,3	13,5	-

Table 2. Agrochemical properties of serozem-meadow soils of the Zhetygen farm after 4 years of irrigation with livestock wastewater in 0 -100 cm layer

Variants of Experiment	humus,%	total nitrogen, %	phosphorus gross,%	potassium mobile, mg / kg	CO, %
1. without watering (control)	0,42	0,018	0,131	217	2,36
II. watering - clean water, 70% NH	0,59	0,036	0,149	296	2,67
III. clean water + livestock wastewater 1:10 . 70% NH	0,064	0,036	0,167	232	4,036
IV. clean water + livestock wastewater 1:10 . 70% NH	0,73	0,038	0,169	296	4,68
V. clean water + livestock wastewater 1:7 . 70% NH	0,85	0,042	0,180	124	6,67
IV. clean water + livestock wastewater 1:7 . 80% NH	0,86	0,062	0,184	280	6,77
VII. clean water + livestock wastewater 1:5 . 70% NH	1,02	0,038	0,178	330	6,14
VIII. clean water + livestock wastewater 1:5 . 80% NH	0,89	0,061	0,186	418	5,69

It is also characteristic that in the cases where the prepared livestock wastewater was used, accumulation of nutrients and especially organic substances along the entire profile of the soil section occurs, in contrast to variant 1, variant 2, where clean water was used. There is an insignificant accumulation of these elements and substances in the main only in 0-40 cm layer.

When using livestock waste, it is very important to control the inflow into the soil of elements of mineral nutrition during the growing season, depending on the moisture availability of the year. We have established for the year 75% of the supply the most optimal mixture is 1: 7, and for 50% of the year 1: 5, and in the dry year 95% of the supply is 1:10. In the condition of Zhambyl region for irrigation of alfalfa, mixing with a ratio of 1: 5 is optimal, and for maize for silage 1: 7.

Table 3 provides recommended doses of feeding nutrients with irrigation water.

Table 3 - Optimal doses of nutrient inputs with clarified livestock wastewaters for the condition of South Kazakhstan.

Culture and base of products	Yield, t / ha	Removal of nutrients, kg/ha			Dosage of nutrients, kg/ha		
1	2	3	4	5	6	7	8
Alfalfa (hay)	13,0	285	103	167	339	119	233
Corn (green mass)	55,0	146	55	222	243	85	167
Barley (grain)	3,0	81	37	60	115	41	79

Such a differentiated approach to the appointment of the norm of introduction of livestock-wastewater (the degree of dilution of prepared livestock wastewaters) will get maximum returns from the irrigation fields and exclude the accumulation of nitrates in agricultural production from the fields, and also provide a favorable ecological and meliorative environment for them.

The salt regime of the soil is to a large extent related to the composition of the absorbed bases. With the increase in their composition of the sodium, will show the signs of soil alkalinization. Research materials show that all soils of the south and southeast of Kazakhstan, irrigated by wastewater, belong to the category of non-alkaline, because the absorbed sodium did not exceed 3%. But there were some peculiarities in the changes of absorbed sodium. Under alfalfa crops, the amount of absorbed sodium decreases in all test sites. Thus, in the plot № 3 in Zhambyl region, where sugar beet and barley alternated until 1980, the content of absorbed sodium increased from 1,81% to 1,97%, and when in 1981 - 1983, alfalfa was cultivated here, it decreased to 1,6%.

Similar results were obtained in the experiments of L.I. Sergienko, who for 12 years watered the perennial grasses with wastewater from the Volga Chemical Combine [1,2,3].

The increase in absorbed sodium also occurred at a permanent culture of barley. In order to avoid an increase in absorbed sodium in soils that reduce fertility, it is necessary to withstand the alternation of crops according to the adopted crop rotation with the production of perennial grasses.

On the sandy loam soils of the «Iliisky» farm, the content of absorbed sodium decreased from 2,54 to 0,86 – to 2.0% when cultivating the zoned and non-traditional crops. These data are completely consistent with the content in the soil of water, soluble sodium, which during the years of research has consistently decreased. This once again confirms that in the wastewaters of Almaty predominate alkaline earth cations.

When the livestock wastewater is used, there is also observed a tendency of increase the saturation of soils with absorbed bases. In that experiment, if at the beginning of the vegetation period (1937) the absorption capacity was 9,74 – 10,40 mg.eq. per 100 g of soil, then at the end of the experiment (1980) it was 10,2 -16,3 mg.eq. per 100 g of soil.

Conclusions

On the control variant (variant 1), the content of absorbed bases in the soil remained at the initial level (10,1 - 10,2) mg-eq per 100 g of soil. In absorbed bases, calcium predominates. On the optimal variant (variant 5) on irrigation regime and concentration of the mixture, the soil absorption capacity is 12,7 - 16,5 mg.eq. per 100 g of soil, and the sodium content is 8,3 – 9,6% of the total absorbed bases. Calcium accounts for 79.2-83.2%. In variants, the sodium content increased (9,2 – 12,3%), which indicates the ongoing alkalinization processes in variants where used increased concentrations of prepared livestock wastewater with clean water (1: 5) and supported the increased pre-irrigation moisture threshold (80% of NH) soils. However, it should be noted that the intensity of alkalinization formation processes is low.

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ҚАЗАҚСТАННЫҢ ОҢТҮСТІГІНДЕ ТӨГІНДІ СУЛАРМЕН СУҒАРҒАНДАҒЫ ТОПЫРАҚ ҚҰНАРЛЫҒЫНЫҢ ЖАҒДАЙЫ

Аңдатпа

Мақалада сұр және шалғынды-батпақты топырақтың түрлеріне байланысты суғаруға төгінді сулардың үш түрі пайдаланылып, жүргізілген лабораториялық, лизиметриялық және эксперименталдық зерттеулердің нәтижелері келтірілген. Сонымен қатар топырақтың құнарлығының тиімділігін бағалау үшін И.Тюрин, М.М.Кононова, П.Мачигин және Протасова, Е.В.Аринушкиннің жіктеулері қолданылды. Таза сумен және төгінді сумен суғару жүргізілген барлық тәжірибелерде топырақтың гумус мөлшері артқандығы байқалды. Әсіресе, мұндай көрсеткіш төгінді сумен суғарғанда көбірек байқалған.

Кілт сөздер: суғару, төгінді сулар, топырақ, химиялық құрамы, қоректік элементтер.

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СОСТОЯНИЕ ПЛОДОРОДИЯ ПОЧВЫ ПРИ ПОЛИВЕ СТОЧНЫМИ ВОДАМИ НА ЮГЕ КАЗАХСТАНА

Аннотация

В статье приведены результаты собственных лабораторных, лизиметрических и экспериментальных исследовании при использовании трех видов сточных вод для полива: в зависимости от типа почв: сероземные и лугово-болотные почвы. Также для оценки эффективности плодородия почвы использовали классификацию И.Тюрина, М.М.Кононовой, П.Мачигина и Протасова, Е.В.Аринушкиной. Во всех опытах, как при поливе чистыми так и сточными водами, наблюдалось увеличение гумуса. Это увеличение при поливе сточными водами проявлялся больше.

Ключевые слова: полив, сточные воды, почва, химический состав, питательные элементы.