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4.1.1 Общее земледелие, растениеводство (сельскохозяйственные науки)

ИЗМЕНЕНИЕ СТЕПЕНИ СОЛОНЦЕВАТОСТИ ПОЧВ В ЗАВИСИМОСТИ ОТ СТРУКТУРЫ СЕВООБОРОТОВ В АРИДНОЙ ЗОНЕ НИЖНЕГО ПОВОЛЖЬЯ

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4.1.1 General agriculture, plant growing (agricultural sciences)

CHANGES IN THE DEGREE OF SOIL SOLONZIC CONSISTENCY DEPENDING ON THE STRUCTURE OF CROP ROTATIONS IN THE ARID ZONE OF THE LOWER VOLGA REGION

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The article discusses the change in the degree of

солонцеватости почв в зависимости от структуры севооборотов, внедренных в условиях аридной зоны. Астраханская область отличается сильной засушливостью климата и низкой продуктивностью региональных почв. В настоящее время 2/3 пахотных земель не используются, на них развивается водная и ветровая эрозия, наблюдаются процессы опустынивания. Тенденции отрицательного баланса гумуса стали возможны в связи с широким распространением монокультуры картофеля. Разрушение научно-обоснованных схем севооборотов привело к превалированию деградационных процессов. В связи с этим необходимы комплексные меры по предотвращению возникшей ситуации

soil alkalinity depending on the structure of crop rotations implemented in the arid zone. The Astrakhan region is characterized by severe aridity of the climate and low productivity of regional soils. Currently, 2/3 of arable lands are not used; water and wind erosion develops on them, and desertification processes are observed. Tendencies of negative humus balance became possible due to the widespread use of potato monoculture. The destruction of scientifically based crop rotation schemes led to the prevalence of degradation processes. In this regard, comprehensive measures are needed to prevent the situation that has arisen.

Ключевые слова: СОЛОНЦЕВАТОСТЬ ПОЧВ, СЕВООБОРОТЫ, АРИДНАЯ ЗОНА

Keywords: SOIL SOLONIZATION, CROP ROTATION, ARID ZONE

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1.INTRODUCTION.

In the second half of the 20th century, in pursuit of profit, irrigation, the use of increased doses of mineral fertilizers and monoculture were widely introduced in many regions of the planet. As a result, significant tracts of agricultural land fell into disrepair.

Today, the problem of preserving soil fertility is one of the most acute in agriculture. Increased anthropogenic influence on the soil, unbalanced and disturbed agricultural landscapes have led to the intensification of degradation processes of the soil cover. On the soils of the arid zone, the most common types of degradation are dehumification, destructuring, overcompaction and salinization.

Processes of intensive soil degradation lead to a significant reduction in fertility and a drop in the yield of agricultural crops, including forage crops.

Intensive use of soils in modern agriculture is a powerful anthropogenic factor that accelerates the development of many negative processes.

Before the transition to market relations, most of the arable land in arid regions was occupied by long-rotation crop rotations. The share of forage crops

reached 2/3 of the total sown area. During the transition period, with a focus primarily on small-scale production and the destruction of many collective and state farms, the area of forage crops, compared to the pre-reform period, decreased by more than 15 times. Peasant farms became the main producers of crop products. Livestock farming, as a less profitable industry, underwent significant changes associated with a reduction in livestock, the destruction of livestock farms and dairy complexes. Forage production, as a related industry, also fell into oblivion. Many researchers at that time actively promoted the destructive impact of irrigation on the agricultural landscape of the territory.

For example, V.E. Prikhodko [9] noted that the miscalculations and failures of irrigation reclamation are related to:

– firstly, with little experience of irrigation in the steppe zone and poor knowledge of many processes occurring in irrigated lands, the absence of landscape, basin, geosystem and global approaches in the design of land reclamation facilities;

– secondly, with a low level of agricultural culture in general and on reclaimed soils in particular;

– thirdly, insufficient funding, the absence of an “enlightened land user” (according to V.V. Dokuchaev) and his economic interest in the results of his work.

Most researchers who have studied the impact of irrigation on the agro-landscape of the territory and the yield of agricultural crops note that degradation processes on irrigated lands in the arid zone are caused by a simplified approach to land irrigation without taking into account the reproductive capacity of the soil.

Lands of the irrigation fund are most susceptible to erosion, and when sprinkled, to the destruction of the structure in the arable layer, soil compaction during irrigation, disruption of the balance of water and air regimes, etc.

In modern conditions, agricultural production in arid zones is undergoing

significant changes associated with the manifestation of degradation processes in soils and increasing desertification trends [8].

In crop production in the Astrakhan region, the main emphasis is on growing potatoes and vegetable crops [3]. In some areas, such as Kharabalinsky and Limansky, which are leaders in potato production, its monoculture is widespread, which became possible due to increased doses of mineral fertilizers [1, 4, 5, 6, 7].

The Astrakhan region is characterized by a very dry climate. The cultivation of most agricultural crops here is possible only under irrigated conditions. At the same time, the soils of the region are characterized by low fertility. Irrational irrigation together with increased doses of mineral fertilizers often lead toIto the emergence of solonetzic soils and solonetz complexes.

2.METHOD.

The research involved studying the degree of soil solonetzization depending on the crops of forage crop rotation. The experiments were carried out from 2018 to 2022 according to the experimental methodology of B.A. Dospekhov [2]. The soils of the Kharabalinsky district of the Astrakhan region are gray-brown semi-desert. The humus content is 0.99%. The soils of the Limansky district are light chestnut, the humus content in the arable layer does not exceed 0.7%.

The degree of soil solonetzization was assessed using the method of I. N. Antipov-Karataev based on the content of absorbed sodium in the soil absorption complex. For this purpose, the amount of absorbed sodium was expressed as a percentage of the absorption capacity, i.e., they found what part of it was occupied by sodium. According to the classification of Antipov-Karataev, if horizon B contains:

less than 5% of the absorbed sodium from the absorption capacity, then the soil is considered non-saline;

5–10% — slightly saline;

10–20% — saline;

more than 20% - solonetz.

The studied forage and grain crops in crop rotation were cultivated according to the agricultural technology recommended for the Astrakhan region.

3. RESULTS.

At present, the alkalinity of irrigated areas is one of the negative consequences of irrational irrigation. This problem is especially acute in the South of Russia, where it is practically impossible to cultivate most agricultural crops in dryland conditions.

The conducted research included studying various irrigation regimes on forage crop rotations. Analysis of the obtained data showed an increase in the degree of soil alkalinity with an increase in irrigation rates (Table 1).

Table 1 - Degree of soil alkalinity depending on the irrigation regime, Kharabalinsky district, 2018...2022.

Culture	65…70% NV (alfalfa, barley) 70…75% HB (potatoes)		70…75% NV (alfalfa, barley) 75…80% HB (potatoes)		75…80% NV (alfalfa, barley) 80…85% HB (potatoes)	
	Exchange sodium,% of capacity	Toxic alkaline t ($NSO3^-$-Ca2+ + Na+ + Mg+), mmol (EQ)//100 G	Exchange sodium, % of capacity	Toxic alkaline t ($NSO3^-$-Ca2+ + Na+ + Mg+), mmol (EQ)//100 G	Exchange sodium,% of capacity	Toxic alkali nost $(NSO)3^-$ -Ca2+ + Na+ + Mg+), mmol (EQ)//10 0 G
Alfalfa	5	0.7	6	0.75	7	0.8
Potatoes le	6	0.75	7	0.8	9	0.9
Barley	7	0.8	8	0.85	10	1.0

Analysis of Table 1 showed thatincreasepre-irrigation threshold of soil moisture has a negative effect on the degree of its alkalinity. For example, when cultivating alfalfa with an irrigation regime of 65...70% HB, the content of exchangeable sodium was 5%, and toxic alkalinity was 0.7 mmol; with an

increase in the pre-irrigation threshold of soil moisture to 75...80% HB, the percentage of exchangeable sodium increased to 7, and toxic alkalinity reached 0.8 mmol. A similar trend was observed in all crops of the grass-grain-row crop rotation in the Kharabalinsky district of the Astrakhan region.

At the same time, the gray-brown soils of the Kharabalinsky district were characterized, according to the gradation of the degree of solonetzicity, as slightly solonetzic. However, the increase in the pre-irrigation threshold of soil moisture contributed to the end of crop rotation, the accumulation of exchangeable sodium and an increase in toxic alkalinity, which ultimately led to the beginning of the formation of solonetzic soils.

A similar trend was observed in the Limansky district of the Astrakhan region (table 2).

Table 2 - Soil salinity depending on the irrigation regime, Limansky district, average for 2018...2022.

Culture	65…70% NV (alfalfa, barley) 70…75% HB (potatoes)		70…75% NV (alfalfa, barley) 75…80% HB (potatoes)		75…80% NV (alfalfa, barley) 80…85% HB (potatoes)	
	Exchangeable sodium, % of capacity	Toxic alkalinity (HCO_3^--Ca2+ + Na+ + Mg+), mmol (EQ)//100 G	Exchangeable sodium, % of capacity	Toxic alkalinity (HCO_3^--Ca2+ + Na+ + Mg+), mmol (EQ)//100 G	Exchangeable sodium, % of capacity	Toxic alkalinity (HCO_3^--Ca2+ + Na+ + Mg+), mmol (EQ)//100 G
alfalfa	6	0.75	7	0.8	9	0.9
winter wheat	7	0.8	8	0.85	10	1
potato	8	0.85	10	1	12	1,2

Maintaining the pre-irrigation soil moisture threshold of no less than 65...70% of the minimum capacity when cultivating alfalfa in the grass-grain-row crop rotation in the Limansky District ensured the exchangeable sodium content at the level of 6%. Increasing the lower threshold of soil moisture to 75...80% of the minimum capacity led to an increase in the exchangeable

sodium content to 9%. The maximum value of the exchangeable sodium content was recorded when growing potatoes (irrigation regime 80...85% of the minimum capacity) and amounted to 12%.

The data in Table 2 indicate that in the Limansky district of the Astrakhan region there is an increase in the level of soil salinity with an increase in the irrigation rate.

4. DISCUSSION.

One of the reasons for the formation of solonetzic soils is that the Astrakhan region is located on the bottom of a former lake - the Khvalynsk Sea, which was exposed 10-15 thousand years ago and the C horizon in regional soils is usually saline. The surface of the region is a shallow, gently undulating accumulative plain complicated by a delta, a delta foreland and a number of islands. In the region, groundwater is located close to the surface, which often leads to secondary salinization due to the rise of groundwater from the C horizon.In order to avoid this, crop production enterprises in the region need to constantly monitor the salt content in the soil (2-3 times during the growing season), use high-quality water for irrigation, be sure to apply organic fertilizers, increase the area under salt-tolerant varieties and implement water-saving irrigation technologies.

To prevent land loss due to erosion and salinization, a comprehensive environmental protection program should be developed at the federal level, providing for:

- monitoring the condition of agricultural lands;
- preservation and increase of soil fertility by replenishing the removal of nutrients with the harvest of field crops;
- meliorative measures aimed at combating erosion and salinization, creation and preservation of agroforestry plantations;
- radical and superficial improvement of natural hayfields, pastures, etc..;
-saturation of crop rotations with perennial leguminous grasses, in

particular alfalfa.

5. CONCLUSIONS, LIMITATIONS AND PROSPECTS.

It has been established that increasing irrigation rates in arid zones has an adverse effect on the degree of soil alkalinity. In the Kharabalinsky district of Astrakhan areaswhen cultivating crops in a grass-grain-row crop rotation using an irrigation regime of 65...70% HB (70...75% HB for potatoes), the content of exchangeable sodium was 5...7%; when increasing the pre-irrigation threshold of soil moisture to 75...80% HB (80...85% HB for potatoes), the percentage content of exchangeable sodium increased to 7...10%.It was found that the increase in the pre-irrigation threshold of soil moisture had a negative effect on the degree of its alkalinity. The unfavorable effect of increasing irrigation rates was also observed in the Limansky District of the Astrakhan Region. In this regard, further research is needed to study the alkalinity of soils in arid zones, the correct selection of crops in crop rotations, and the implementation of soil protection measures to prevent the emergence of solonetz complexes.

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