Key words: control, dry farming, samples, growth period, plant height, vegetation period, unfavorable conditions, quality indicators.

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ASSESSMENT OF THE REASONS FOR DEGRADATION OF MEDIUM KASTANOZEM SOILS IN KOSTANAY REGION

Abstract

The article considers the issues of establishing the root causes of degradation processes on medium kastanozem soils of fallow pastures in the dry-steppe zone of the Kostanay region. It was found that the main reason for the sharp decline in the fertility of medium kastanozem soils that were previously used for arable land was soda-sulphate salinization of the arable and sub-arable horizons. Against the background of small annual and seasonal variability of climatic factors, the intensity of this process most likely depended on the frequency and intensity of deflationary and erosive processes and on the agrotechnical measures taken to improve the water, heat, air regimes and the structural state of the soil. Sulfate salinization covers the entire meter-thick layer of medium kastanozem soil with a gradual increase with depth. The results obtained are a theoretical basis for solving issues of rehabilitation of anthropogenically degraded medium kastanozem soils for their re-involvement in arable land. The conducted studies revealed several issues requiring further research, such as the genesis of soda, the nature and intensity of successional processes, crop yield forecasts and the modern development of fallow landscapes in general.

Key words: medium kastanozem soils, degradation, structure, climate, salt regime, salinization, succession, productivity.

Introduction

Cropland degradation has become a critical issue of global concern worldwide, where soil erosion, chemical deterioration and physical degradation are important parts among various types of degradation [1]. Croplands in the chernozem soil regions are facing a crisis due to degradation problems and loss of production capacity. For example, in the grain-growing chernozem soil region of Jilin Province in northeastern China, cropland soils are facing significant degradation problems such as depletion of organic matter, thinning of the arable layer, compaction, erosion and salinization [2,3]. The above processes are widespread in northern and central Kazakhstan, where not only chernozem soils but also kastanozem soils still have high energy potential [4]. However, at present, the condition of kastanozem soils in the dry steppe zone, where solonetz and solonetzic soils reign, is of great concern. As is known, kastanozem soils, like other soils of grain-growing regions of Kazakhstan, have been actively involved in agricultural circulation since the beginning of the development of virgin lands, and various complex adaptive-landscape farming systems have been developed to protect them [5]. According to [6], over 18 million hectares of new land on flat landscapes were plowed up in Kazakhstan from 1954 to 1960. The rate of soil development gradually increased. The culture of agriculture increased. However, despite the latter, a fairly high degree of water erosion and deflation still remains on the kastanozem soils of the Akmola, Kostanay, North

Kazakhstan, Pavlodar and Karaganda regions [7]. Currently, 10.2 million hectares of the total area (20.7 million hectares) of kastanozem soils in the dry steppe subzone are used in agriculture [8]. However, recently previously unknown degradation processes have begun to be discovered on the steppe soils of non-irrigated arable land, leading to a significant drop in their fertility. This circumstance has led to the fact that many thousands of hectares of used land have simply become unsuitable for farming [9]. Such lands gradually began to move into the category of pastures, which began to develop themselves in close connection with the environment. In this regard, the purpose of our research was to establish the causes of degradation processes on medium kastanozem soils of the dry-steppe zone of the Kostanay region, which were used for arable land for a long time and were eventually transferred to the category of fallow pastures due to a sharp decrease in the yield of agricultural crops on them. To achieve this goal, we studied their chemical composition of the solid phase and pore solution, as the main indicator of assessing their productivity and effective fertility. The development of research in this direction will allow us to correctly assess the fertility of not only medium kastanozem soils, but also others that turned out to be low-productive due to degradation processes.

Materials and methods

To determine the reasons for degradation processes of medium kastanozem soils on temporary pastures of the Kostanay region, field studies were conducted at the Arkalyk Agricultural Experimental Station (AAES) in 2018 and 2023. The main crops grown are wheat, barley, chickpeas, as well as Sudan grass and wheatgrass. The total area of sown fields in the farm at the moment 1991 was more than 50 thousand hectares (64,110 hectares), then it decreased sharply. The current financial situation of the farm made it possible to increase the area of sown fields to 25 thousand hectares (24,791 hectares). The object of the study was medium kastanozem soils that were withdrawn from circulation and transferred to fallow pastures due to a sharp decrease in crop yields on them. The indicated soils characterize field No.59, which has not been cultivated for more than 6 years and is located in the extreme south-eastern corner of the land use (Figure 1).

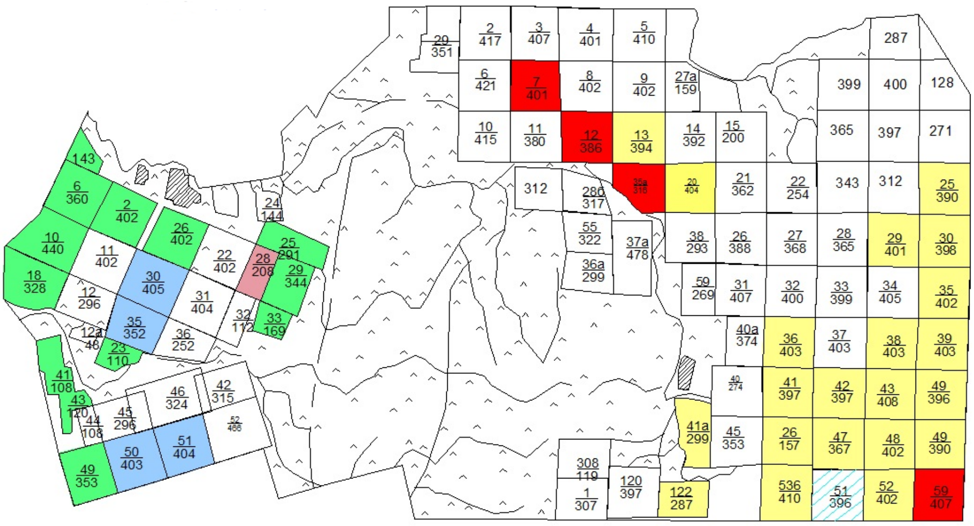

Figure 1 – Land use plan of AAES

One of the main forms of studying pasture resources is a field expeditionary survey, including various research methods in key areas. In the autumn (12.09.2018), we laid a main soil pit up to 110 cm deep on the selected field, which, at a detailed scale (1:2000) with the first category of complexity according to the methodology, characterizes 4.0 hectares of area [10]. In the field, typical locations for pitting on medium kastanozem soils were determined by the nature of the main forms of microrelief, vegetation and soil surface. The nature of the surface, the main types of plants and the projective cover of the soil surface were described. The condition of the surface in kind and in perspective, as well as soil profiles, were photographed. The morphogenetic properties of the soil were described and studied. All genetic horizons were exposed in the pit, including the upper part of the parent rock. From each of them, according to the methodology, soil samples weighing 0.4 kg were selected [10]. The taken soil samples were analyzed for their chemical composition in accordance with the established methods below [11]:

- determination of humus according to the method of I.V. Tyurin (ST RK 3477-2019);
- determination of total nitrogen according to Kjeldahl (GOST 26107-84);
- determination of mobile phosphorus and potassium according to B.P. Machigin (GOST 26205-91);
- determination of the structural and aggregate composition of soils using the method of N.I. Savvinov as modified by I.B. Revut;
- ionic composition of water extract from soils according to K.K. Gedroits, the sum of salts and pH obtained from a soil suspension with a soil to water ratio of 1:5 (GOST-26423-85).

To determine the relationship and interdependence of the yield of pasture plants of medium kastanozem soils on climatic conditions, we analyzed their indicators for the growing season from 2020 to 2024 according to the Arkalyk Ashutasty weather station [12].

To determine the biological indicators of plant communities on temporary pastures of medium kastanozem soils, we randomly selected areas within the selected fallow fields (7, 12, 35A, 59) with different periods of non-use, where biometric measurements (height) and accounting of the yield of above-ground plant phytomass on an area of $1 \times 1 = 1$ m^2 were carried out in triplicate. Subsequently, the collected plant samples were weighed before and after drying on electronic scales. Research work related to biological indicators (projective soil cover by plants, pasture yield) was carried out according to proven generally accepted methods [13, 14].

Results and discussion

As is known, plant productivity in biocenoses and agrocenoses strongly depends on climatic factors. In this regard, we analyzed long-term seasonal climate indicators in the context of their impact on the decrease in plant productivity in fallow lands with different periods of non-development.

For the months of March-September, the highest sum of average temperatures (150.2 and 145.3°C) of air was observed in 2021 and 2023, respectively (Table 1). The year 2024 is characterized by a comparatively low value. However, temperature fluctuations by month are ambiguous. If we compare summer air temperatures by year, the highest temperatures in July were observed in 2023, where the value was 24.8°C. And in August, high air temperatures were established in 2021 and 2023 at the level of 22.9 and 20.2°C, respectively. Warmer springs were in 2020, where the air temperature in April and May were 9.3 and 17.4°C, respectively. In April, relatively high air temperatures were recorded in 2020, 2022 and 2024 (9.3, 9.1 and 9.8°C). Early autumn (September) air temperatures showed that 2022 and 2023 were warmer (15.3 и 12.4°C).

Table 1 - Average long-term air temperature during the growing season, °C

Years	March	April	May	June	July	August	September	Average for 7 months
2020	-2.8	9.3	17.4	18.9	22.5	19.8	11.5	13,8
2021	-8.2	6.8	19.0	21.3	22.8	22.9	11.3	14,9
2022	-8.7	9.1	15.7	20.1	22.4	19.6	15.3	13,4
2023	-0.4	7.0	16.3	21.2	24.8	20.2	12.4	14,5
2024	-5.8	9.8	12.0	21.9	21.0	18.7	11.9	12,8

The lowest temperatures during the growing season were in the summer months. They were 21.0 and 18.7°C in July and August, respectively.

Analysis of precipitation during the growing season showed that the highest precipitation during this period was in 2020 and 2023, amounting to 215 and 183 mm, respectively. 2021 and 2022 turned out to be significantly driest years, with only 123.0 and 87.0 mm of precipitation. For example, in 2023, in the late spring and summer months (May, June, July), there was an insignificant amount of precipitation, only 9.0, 7.0 and 13.0 mm (Table 2). Whereas in 2022, 8.0, 12.0 and 23.0 mm of precipitation fell during the same period. This indicates that in the indicated years, due to the strengthening of the desiccation-exudative water regime, water-soluble salts are not leached out, but are restored, as indirectly evidenced by the ionic composition of the water extract of medium-chestnut soils of field No. 59.

Table 2 - Precipitation during the growing season, mm

Years	March	April	May	June	July	August	September	In just 7 months
2020	3	54	27	26	61	16	28	215
2021	17	4	32	10	24	0.4	36	123
2022	21	10	8	12	23	8	5	87
2023	14	8	9	7	13	62	70	183
2024	13	15	36	10	60	38	7	179

In the early autumn period (September), the lowest amount of precipitation (8.7 mm) was also recorded in 2022 and 2024. Thus, 2021 and 2022 should apparently be considered abnormally hot in comparison with other years. These phenomena undoubtedly have a negative impact on plant productivity. However, it is practically impossible to assess the impact of long-term weather conditions on plant productivity without taking into account and studying the processes of physical degradation, salinization and solonetzicity. In the latter case, the subzones of kastanozem soils, as noted above, are the kingdom of solonetz and solonetzic soils.

Long-term intensive cultivation of fields and the use of heavy agricultural machinery and other factors lead to physical degradation of soils. The most superficial layer of soil is affected, their composition and structure deteriorate. In this connection, we have assessed the structural and aggregate composition of medium kastanozem soils that have not been used for different years (14.03.2023). The results have shown that the comparatively best structure is possessed by medium kastanozem soils of field No. 12, which has not been used for 3 years. In the soils of the noted field, the coefficient of soil structure is 4.6, and the amount of agronomically valuable aggregates of 0.25-10 mm in size was 78.71% and blocky macroaggregates of >10 mm in size were 17.00% (Table 3). Based on the content of aggregates of 0.25-10 mm in size, the structural state of medium- kastanozem soils in field No. 12 can be assessed as good. Moreover, microaggregates of <0.25 mm in size were not detected.

Table 3 - Structural and aggregate composition of kastanozem soils of Kostanay region (dry sifting)

Field №	Non-development period, year	Depth, cm	Aggregate composition, %			
			Size of aggregates, mm			Structural coefficient (K)
			>10	10-0,25	<0,25	
7	4	0-10	30,56	59,41	-	1,9
12	3	0-10	17,00	78,71	-	4,6
35A	2	0-10	28,24	68,60	-	2,4
59	6	0-10	27,14	55,73	3,79	1,8

Deterioration of the structural condition of medium kastanozem soils after long-term anthropogenic load is observed in field No. 59, which has not been used for 6 years and is currently an abandoned fallow pasture. This is indicated by the coefficient of soil structure, which is equal to 1.8. In this indicator, the medium kastanozem soils of field No. 59 are significantly inferior to others. At the same time, the destruction and fragility of the structure of the upper humus layer (0-10 cm) is indicated by the formation of microaggregates of <0.25 mm in size in the amount of 3.79%, while they are absent in other fields. Based on the content of agronomically valuable aggregates of 0.25-10 mm in size, one can judge the medium kastanozem soil of field No. 59 to be on the border of good and satisfactory (55.73%). Thus, the reduction of agronomically valuable aggregates, the appearance of coarse and fine microstructure and, finally, the loose structure contributed, apparently, to wind and partly water erosion of the studied soils.

To understand the succession processes associated with the restoration of vegetation on fallow lands after many years of agricultural use, we studied the productivity of the aboveground mass of plants. The selected fields of the station at the time of the study (12.09.2018) have different periods of non-use. For example, in field #7, which has not been used for 4 years, the yield of the raw above-ground mass of plants was 20.7 c/ha (Table 4). Whereas in field #35A, which has not been used for only 2 years, the fresh phytomass of plants is significantly higher (31.0 c/ha). And in field #59, where we laid a soil pit, despite the long period of stay (6 years) without processing, the yield of plants is not so high (33.8 c/ha) compared to the previous field. This is most likely due not to climatic factors, but to the condition of the soil itself. Therefore, to determine the reasons for such a low yield of plants in field #59, which has not been used for 6 years, we continued research on the chemical composition of medium kastanozem soil.

Table 4 - Average phytomass of natural successional plants on fallow lands of medium kastanozem soils

Field #	Non-development period, year	Aboveground mass yield, c/ha			
		grass stand		decline	
		fresh	air-dry	fresh	air-dry
7	4	20,7	14,0	17,0	17,0
12	3	29,5	18,0	12,0	12,0
35A	2	31,0	25,0	00,0	00,0
59	6	33,8	20,3	12,0	9,3

As a result of a field survey of the territory of the farms of the Arkalyk Agricultural Experimental Station, it was found that medium kastanozem soils have different levels of fertility. This is clearly evidenced not only by the nature of the soil surface, but also by the noticeable spotting of the vegetation cover. The latter indicates the presence of solonetzic soils of medium kastanozem soils and solonetz. To find out the reason for the decrease in the productivity of medium kastanozem soils, which were previously used for arable land, we laid a pit (12.09.2018) in field No. 59 in the autumn. The relief of the area as a whole is characterized by a plain with microdepressions. The land had previously been used for arable land for a long time, but for 6-7 years it had not been cultivated and in some places was a place of concentration of livestock for their grazing. The vegetation cover mainly includes Erysimum (*erysimum cheiranthoides*), over 60-70 cm high, Sonchus up to 60-70 cm high, 10 to 60 cm high, Kochia 10- 60cm high, Convolvulus (*convolvulus arvensis*) and a significant amount of 10 to 60 cm high Lactuca. Their projective surface cover was about 50-60%. Cracks and fissures about 4-5 cm wide are clearly visible on the soil surface, which open up in the summer and autumn months (Figure 2). Their genesis is associated not so much with weather conditions, but apparently with the processes of salinization and solonetzification.

Figure 2 - Form and size of a crack in an unused arable land for several years

Below we present the results of studying the morphology of the structure of the profile of medium-kastanozem soils of the studied area. Here, the recovering vegetation, which has been growing for more than 6 years, creates a characteristic image of degraded soils. The data of the morphological description of the genetic horizons of degraded medium-kastanozem soils showed that they were formed on heavy saline parent rocks. The upper humus horizon contains few carbonates, but with depth the carbonate content of the soil increases. This is clearly evidenced by the release of carbonates in the form of noticeable spots. Starting from a depth of 90 cm, horizontally located layers of whitish fine-crystalline gypsum of small thickness (h> 2 cm) are found. Together with it, up to a depth of 110 cm, the mineral mass of the soil is saturated with carbonates (Figure 3). From the structure of the profile, it is clear that the studied soil has lost its original structure. The upper soil layer, which has a looser structure and weak structure, has been subjected to strong anthropogenic impact. It is colored gray, sufficiently moistened and penetrated by plant roots, which, together with the above-ground litter, will be involved in the process of humification in situ.

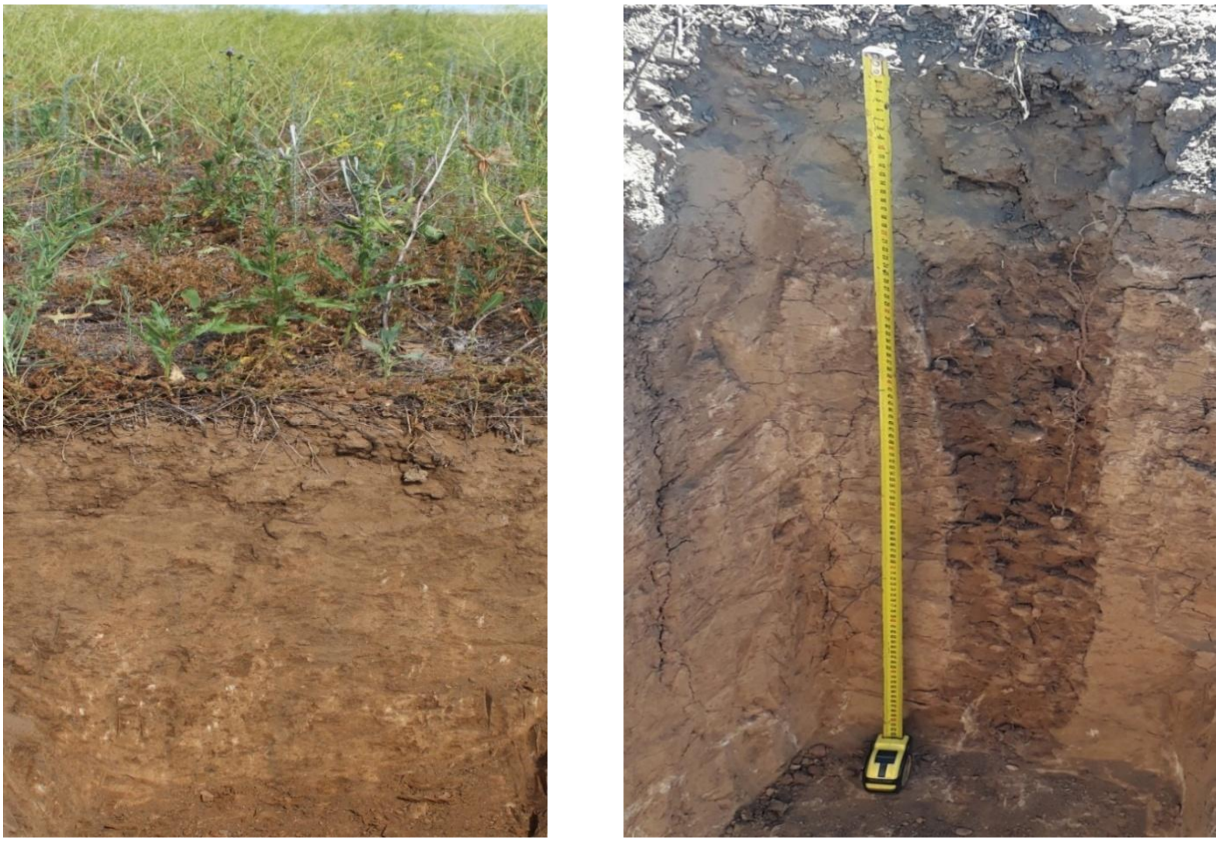

Figure 3 - Profile of kastanozem soil on territory unused for more than 6 years

Anthropogenically degraded medium kastanozem soils of fallow lands (field 59) have a medium-thick (A + B_1 = 41-80 cm) humus horizon. In its former arable horizon in the 0-30 cm layer, the humus content is on average 2.48%, which indicates that the soil is weakly humified, but generally provided with organic matter (Table 5). In terms of total nitrogen content, fallow medium kastanozem soils are moderately provided (0.230%) in the uppermost 0-10 cm layer and moderately low provided (0.141 and 0.130%), respectively, in the underlying layers. The studied soils are moderately supplied with mobile phosphorus (2.80 and 2.15 mg per 100 g of soil) in the upper layers (0-10 and 10-20 cm) and low-supplied (1.25 mg per 100 g of soil) in the 20-30 cm layer. It is noteworthy that the fallow medium-kastanozem soils are very low in mobile (exchangeable) potassium. It’s content in the 0-30 cm layer averages 2.47 mg per 100 g of soil.

Table 5 – Chemical composition of medium-kastanozem soils

Sampling location %	Depth, cm	Total humus, %	Total nitrogen, %	Mobile phosphorus, P_2O_5 mg per 100g of soil	Potassium,K_2O mg per 100g of soil
Field 59	0-10	2,91	0,230	2,80	2,91
	10-20	2,52	0,141	2,15	2,35
	20-30	2,00	0,130	1,25	2,15

The salt composition of fallow medium kastanozem soils shows the salinity of its entire thickness from the surface to a depth of 120 cm. Moreover, the deeper, the soil salinity gradually increases from weak to strong. Only the uppermost layer (0-10 cm) is weakly salinized, where the total content of water-soluble salts is 0.174%. Even deeper, the degree of soil salinity increases to medium and remains at this level to a depth of 70 cm. In this interval (10-70 cm), the salt content varies from 0.271 to 0.373%. Starting from a depth of 70 cm to the bottom of the section, the salinity of medium kastanozem soils reaches its maximum values and corresponds to a strong level. In the noted thickness (70-120 cm) of the soil ground, the total content of water-soluble salts fluctuates from 0.402 to 0.628%. The reaction of the medium kastanozem soil throughout its thickness is slightly alkaline (pH 7.4-7.6). In the soil solution, its ionic composition is of considerable interest, since the ions are distributed unevenly in it and have a toxic content for plants. For example, sulfate ion dominates in the composition of anions, its share reaches from 60 to 80% of the total amount of all anions (Table 6). Therefore, the chemistry of salinization of fallow abandoned medium kastanozem soils is purely sulfate, except for the uppermost layers (0-10 and 10-20 cm). In the latter, the chemistry of salinization is hydrocarbonate-sulfate. The toxic effect of sulfate ion already begins from the soil surface at a depth of 10 cm, and its content gradually increases with depth from 1.90 to 8.20 mg-eq per 100 g of soil. The high content of this ion in the lower layers indicates that the studied soils were formed on heavy loamy sulfate soil-forming rocks. The content of sulfate ion throughout the entire thickness significantly exceeds its toxicity threshold (1.7 mg- eq per 100 g of soil).

In addition to the sulfate ion, the noticeable concentration of hydrocarbonate and carbonate ions is of concern. The content of the former can have a negative effect starting from a depth of 20 cm from the day surface. To a depth of half a meter, the concentration of hydrocarbonate ion reaches the pore level (0.76-0.80 mg-eq per 100 g of soil). Quite a noticeable concentration of this ion from the point of view of harmfulness is also noted in the layers of 70-80, 80-90, 100-110 and 110-120 cm, where it fluctuates from 0.80 to 1.20 mg-eq per 100 g of soil, i.e. equal to and exceeds the toxicity threshold (0.8 mg-eq per 100 g of soil). Soda, the most toxic compound among harmful salts, is involved in the process of salinization of abandoned medium kastanozem soils. This is evidenced by the toxic concentration of normal carbonates in the thickness of 40-70 cm of the studied soils. Its content in this interval significantly exceeds the threshold level (0.03 mg-eq per 100 g of soil) and fluctuates from 0.48 to 0.64 mg-eq per 100 g of soil. In other parts of the soil profile, fragmentary traces of carbonate ion appear. Sodium predominates in the cation composition. Moreover, its concentration increases with depth and reaches maximum values in the parent rock (7.52-7.64 mg-eq per 100 g of soil). A noticeable concentration of sodium ion above the threshold level (> 2.0 mg-eq per 100 g of soil) is observed from a depth of 20 cm. Thus, the salt composition of fallow medium-kastanozem soils is represented by salts such as Na_2SO_4, $NaHCO_3$ and Na_2CO_3.

Table 6 – Ionic composition of water extract of medium-kastanozem soils under vegetation at the recovery stage, mg-eq per 100 g of air-dry soil %

Field #	Sampling depth, cm	HCO_3^-	CO_3^{2-}	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+ $+K^+$	pH	Total salts in %
59	0-10	0,72		0,40	1,70	1,00	0,50	1,32	7,7	
		0,044	traces	0,014	0,06	0,020	0,006	0,030		0,174
	10-20	0,64		0,50	1,90	1,00	0,60	1,44	7,4	
		0,039	none	0,018	0,091	0,020	0,07	0,033		0,271

	20-30	0,76		0,30	3,45	1,00	0,50	3,01	7,3	
		0,046	none	0,011	0,166	0,020	0,006	0,069		0,318
	30-40	0,76		0,40	3,55	0,90	0,50	3,31	7,5	
		0,046	traces	0,014	0,171	0,018	0,006	0,076		0,331
	40-50	0,80	0,48	0,20	3,70	0,80	0,40	3,98	7,6	
		0,049	0,014	0,07	0,178	0,016	0,005	0,092		0,424
	50-60	0,60	0,48	0,30	4,00	0,90	0,50	3,98	7,6	
		0,037	0,014	0,014	0,192	0,018	0,006	0,092		0,373
	60-70	0,68	0,64	0,50	4,10	1,20	0,50	4,22	7,6	
		0,041	0,019	0,018	0,197	0,024	0,006	0,097		0,402
	70-80	1,20		0,30	4,15	1,00	0,40	4,29	7,6	
		0,073	none	0,011	0,199	0,020	0,005	0,098		0,406
	80-90	0,80		0,40	5,20	1,20	0,60	4,60	7,4	
		0,049	none	0,014	0,250	0,024	0,007	0,106		0,450
	90-100	0,48		0,40	7,80	1,50	0,60	6,58	7,5	
		0,029	traces	0,014	0,375	0,030	0,007	0,151		0,606
	100-110	0,92		0,50	8,20	1,40	0,70	7,52	7,5	
		0,056	traces	0,018	0,394	0,028	0,008	0,173		0,677
	110-120	0,84		0,50	7,50	0,90	0,40	7,64	7,4	
		0,051	none	0,018	0,360	0,018	0,005	0,176		0,628

From the given data on the salt composition of medium kastanozem soils it follows that the main reason for their withdrawal from arable land was soda-sulphate salinization of the upper root-inhabited layer, which contributed to a sharp decrease in the yield of agricultural crops. At the beginning of the development of medium kastanozem soils, the negative impact of harmful salts, apparently, was not so noticeable. However, after many years, due to the use of a system of agricultural measures, they led to the widespread development of wind erosion processes. The development of deflationary processes apparently led to a shortening of the arable horizon, and long-term deep cultivation to artificial mechanical inversion of horizons A and B [15]. The noted anthropogenic processes with moisture accumulation and irrigation measures created a cumulative effect, i.e. led to the dissolution and movement of water-soluble sulphate salts upward by descending water currents. A prerequisite for further, more in-depth research is the question of the formation and accumulation of soda in the soil solution at a depth of 40-70 cm.

From the above, it follows that degradation processes on medium-kastanozem soils are associated with a series of human activities that led to the contraction of additional portions of salts to the arable horizon. For the rehabilitation of the studied soils, it is necessary to carry out reclamation measures against soda-sulphate salinization and solonetzification. Using an integrated approach to land resource assessment, adaptation measures can be developed that take into account the characteristics of specific territories and increase the resilience of agriculture to external environmental factors [16].

Despite the salinization processes on fallow medium-kastanozem soils, processes of secondary restoration succession of vegetation occur, as evidenced by their productivity.

Conclusion

In the subzone of medium kastanozem soils of the Kostanay region, fields began to be removed from the composition of arable land due to their low productivity. Over time, such areas passed into the category of pastures with a set of acquired negative properties. In order to clarify the causes of degradation processes on medium kastanozem soils, special studies were conducted to study their chemical composition. It was found that medium kastanozem soils of fallow lands are moderately and highly saline throughout the profile. The bulk of salts is concentrated in the underlying layers, which indicates that the studied soils were formed on heavy loamy saline parent rocks. Here, the content of water-soluble salts reaches 0.628-0.677%, while within the first half meter it varies from 0.174 to 0.424%. In the ionic composition, sulfate and sodium ions predominate, as well as hydrocarbonates and carbonates in significant quantities. The latter with sodium ion forms soda, which is the most toxic among harmful compounds. Its significant accumulation is established in the thickness of 40-70 cm, where normal carbonates vary from 0.48 to 0.64 mg-eq per 100 g of soil. The share of sulfate ion reaches 60-80% of the sum of all anions, which indicates its absolute superiority and purely sulfate chemistry of salinization.

In order to involve anthropogenically degraded saline and solonetzic medium kastanozem soils of the dry steppe zone back into arable land, it is necessary to develop and implement complex reclamation measures. In theoretical terms, the soils also need to study the genesis of soda (Na2CO3), which was formed at a depth of 40-70 cm. In this regard, a hypothesis for further research may be that the long-term development of deflation and erosion processes, which could well lead to a shortening of the arable horizon, then it is possible to assume the approach of the soda horizon to the day surface and the participation of the soda solution in the process of salinization of the root layer.

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ҚОСТАНАЙ ОБЛЫСЫНДАҒЫ ОРТАША ҚАРА-ҚОҢЫР ТОПЫРАҚТАРДЫҢ ДЕГРАДАЦИЯЛАНУ СЕБЕПТЕРІН БАҒАЛАУ

Аңдатпа

Мақалада Қостанай облысының құрғақ дала аймағындағы тыңайған жайылымдардың орташа қара-қоңыр топырақтарында деградация процестерінің түпкі себептерін анықтау мәселелері қарастырылған. Бұрын егістік жерлерге пайдаланылып келген орташа қара-қоңыр топырақтардың құнарлылығының күрт төмендеуінің негізгі себебі жыртылыс және жыртылыс асты қабаттарының содалы-сульфатты сортаңдануы екені анықталды. Климаттық факторлардың шағын жылдық және маусымдық өзгермелілігі жағдайында бұл процестің қарқындылығы дефляциялық және эрозиялық процестердің жиілігі мен қарқындылығына және топырақтың су, жылу, ауа және құрылымдық жағдайларын жақсартуға бағытталған агротехникалық шараларға байланысты болуы әбден мүмкін. Сульфатты сортаңдану орташа қара-қоңыр топырақтың бір метр қалыңдықты түгел қамтиды және тереңдікке қарай бірте-бірте ұлғаяды. Алынған нәтижелер антропогендік деградацияға ұшыраған орташа қара-қоңыр топырақтарын егістік алқаптарға қайтадан оралту үшін реабилитация мәселелерін шешудің теориялық негізі болып табылады. Жүргізілген зерттеулер соданың генезисі, сукцессиялық процестердің сипаты мен қарқындылығы, өнімділікті болжау, және жалпы бұрын тыңайған ландшафттардың заманауи дамуы сияқты қосымша зерттеуді қажет ететін бірнеше мәселелерді анықтады.

Кілт сөздер: орташа қара-қоңыр топырақ, деградация, түйіртпектілік, климат, тұз құбылымы, сортаңдану, сукцессия, өнімділік.

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ОЦЕНКА ПРИЧИН ДЕГРАДИРОВАННОСТИ СРЕДНЕКАШТАНОВЫХ ПОЧВ КОСТАНАЙСКОЙ ОБЛАСТИ

Аннотация

В статье рассматриваются вопросы установления первопричин деградационных процессов на среднекаштановых почвах залежных пастбищ сухостепной зоны Кустанайской области. Установлено, что главной причиной резкого снижения плодородия среднекаштановых почв, которые ранее использовались под пашню стало содово-сульфатное засоление пахотного и подпахотного горизонтов. На фоне небольшой годовой и сезонной вариабельности климатических факторов интенсивность этого процесса с большой вероятностью зависел от частоты и интенсивности дефляционных и эрозионных процессов и от проведенных агротехнических мероприятий, направленных на улучшение водного, теплового, воздушного режимов и структурного состояния почв. Сульфатное засоление охватывает всю метровую толщу среднекаштановой почвы с постепенным увеличением с глубиной. Полученные результаты являются теоретической основой в решении вопросов реабилитации антропогенно-деградированных среднекаштановых почв для вовлечения их снова в пашню. Проведенные исследования обнажили несколько вопросов, требующих дальнейших исследований, таких как генезис соды, характер и интенсивность сукцессионных процессов, прогноз урожая и современное развитие залежных ландшафтов в целом.

Ключевые слова: среднекаштановые почвы, деградация, структурность, климат, солевой режим, засоление, сукцессия, урожайность.

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ОЦЕНКА КАЧЕСТВА ЗЕРНА ГОРОХА ПОСЕВНОГО (Pisum sativum L.) В УСЛОВИЯХ СУХОСТЕПНОЙ ЗОНЫ СЕВЕРНОГО КАЗАХСТАНА

Аннотация

В ТОО «НПЦЗХ им. А.И. Бараева» проводятся научные исследования, направленные на изучение продуктивности и качества семян гороха посевного (Pisum sativum L.) в процессе создания новых сортов. В ходе исследований определены биохимические показатели (содержание белка и крахмала), физические свойства (масса 1000 зерен, пленчатость), а также кулинарные характеристики (вкус, цвет, равномерность, время варки, коэффициент разваримости и общая балловая оценка) зерна. Содержание белка в исследуемых генотипах варьировалось от 24,03% до 26,70%, крахмала — от 40,20% до 46,90%. Максимальные показатели установлены в зерне следующих линий: белок — 26,70% в линии 1-09-5R7, крахмал — 46,90% - 54-08-6. Более крупное зерно отмечено у генотипов 102-04-8 (252,1г.), 31-07-1 (223,0г.). Высоким натурным весом характеризовались линии 54-08-6 и 31-07-1 (811г/л). Средний показатель коэффициента разваримости составил 4,8 балла, цвет вареных семян — 4,6 балла. Кулинарную оценку в 4,8 балла на уровне сорта стандарта Касиб получили линии 1-09-5R7, 326-98№2с24 и 93-04-2-2. Анализ данных показателей позволил выделить исходный материал для создания высококачественных форм гороха. Показано, что научные исследования сосредоточены на изучении качества семян с целью выведения новых сортов, оптимально адаптированных для выращивания в производственных условиях.

Ключевые слова: *белок, горох посевной, генотип, сорт, крахмал, качество, кулинарная оценка*

Введение

Зернобобовые культуры имеют огромное значение в мировом сельском хозяйстве благодаря своим высоким пищевым качествам [1]. Одной из таких культур в Северном Казахстане является горох посевной (Pisum sativum L.), который отличается высокой пищевой ценностью благодаря высокому содержанию белков, жиров и углеводов. Он используется в различных отраслях пищевой промышленности и кормлении животных [2]. Горох посевной служит ценным источником растительного белка, который находит широкое применение как