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ENVIRONMENTALLY SIGNIFICANT INDICATORS OF MOUNTAIN MEADOW SOILS IN AZERBAIJAN

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ЭКОЛОГИЧЕСКИ ЗНАЧИМЫЕ ПОКАЗАТЕЛИ ГОРНО-ЛУГОВЫХ ПОЧВ АЗЕРБАЙДЖАНА

Abstract. The most widespread soils in the Republic of Azerbaijan are mountain-meadow soils. The aim of the research was a comprehensive and comparative study of morphodiagnostic parameters, physical and chemical properties, as well as the biochemical activity of natural and anthropogenically modified biogeocenoses of the Kedabey region. The area has unique flora and fauna. Surroundings of the villages Gara Murad, Kichik Garamurad, Saratovka and others were investigated. The research was carried out on virgin and cultivated lands in villages. The degree of mineralization of the rivers Zayamchay and Chekhrichay ranges from 140 to 430 mg. The groundwater level in these areas exceeds 2 m, salinization processes are active. A herbarium was collected and the floristic composition of natural cenoses was determined. Invertebrates were also collected and the dominant composition of the fauna of natural cenoses was determined. Of the saprophages in these biocenoses, woodlice of the genus *Hemilepisthus* and *Armadillidium* are widely used. The most intensive decomposition of the remains of cereal vegetation is observed in the soil of the coastal strip (65.9%). In the natural cenosis, the rate of destruction of saltwort and salt-tolerant grass vegetation reaches 44.3%. The main role in the destruction of plant remains is played by a group of saprophages, which actively use plant litter. The decomposing material reaches its final stage of microbiological transformation. The duration and amount of CO₂ in different soil horizons were also studied. It has been established that with increasing depth, the amount of carbon dioxide decreases. The hydrolytic activity of invertase and urease enzymes in the studied soils can be assessed as very weak. Comparative results of all these agrochemical studies helped to develop virgin soils in agriculture on the plains and achieve high productivity.

Keywords: humification, decomposition, chemical parameters, classification, salinization, invertebrates.

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Аннотация. Наиболее распространенными почвами в Азербайджанской Республике являются горно-луговые почвы. Целью исследований стало комплексное и сравнительное изучение морфодиагностических параметров, физико-химических свойств а также биохимической активности естественных и антропогенно измененных биоеоценозов Кедабейского района. Район имеет уникальную флору и фауну. Были исследованы окрестности сел Гара Мурад, Кичик Гарамурад, Саратовка и другие. Исследования проводились на целинных и обрабатываемых землях в селах. Степень минерализации рек Заямчай и Чехричай колеблется от 140 до 430 мг. Уровень грунтовых вод в этих районах превышает 2 м, процессы засоления идут активно. Был собран гербарий и определен флористический состав природных ценозов. Также были собраны беспозвоночные и определен доминирующий состав фауны природных ценозов. Из сапрофагов на этих биоценозах широкое распространение получили мокрицы рода *Hemilepisthus*, *Armadillidium*. Наиболее интенсивное разложение остатков злаковой растительности отмечается в почве прибрежной полосы (65,9%). На естественном ценозе темпы деструкции солянковый и солеустойчивой злаковой растительностью достигает 44,3%. В деструкции растительных остатков главную роль играет группа сапрофагов, которые активно используют растительный опад. Разложившийся материал достигает своей конечной стадии микробиологического превращения. Также изучались продолжительность и количество CO₂ в разных горизонтах почвы. Установлено, что с увеличением глубины количество углекислого газа уменьшается. Гидролитическую активность ферментов инвертазы и уреазы в изучаемых почвах можно оценить как очень слабую. Сравнительные результаты всех этих агрохимических исследований помогли освоить целинные почвы в земледелии на равнинах и добиться высокой продуктивности.

Ключевые слова: гумификация, разложение, химические показатели, классификация, засоление.

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Introduction. Azerbaijan possesses 9 of 11 world climatic zones, which are characterized by the development of unique and endemic soil types [1; 9; 11].

The meadow soil type was first studied in 1908 in Central Asia. The formation of mountain meadow soils is mainly on lyos rocks [8; 10].

The latitude and longitude of the study area is in this range E 45° 0'–47° 08' N 41° 17'–40° 19'. Average annual humidity 75%, annual precipitation 600–900 mm. The average annual wind speed is 2.2 m/s [9]. Possible evaporation occurs at a distance of 1169–1119 mm from the surface of the coating. From April to November, there is more evaporation than precipitation, and the soil during this period experiences a lack of moisture. The groundwater level is deep [20].

Experimental part. Gadabay has its unique flora and fauna. Studies were carried out in the villages of Gara Murad, Saratovka, Slavyanka, Kichik Garamurad and river valleys (in 2017–2019 years). Herbarium materials were collected and the floristic composition was determined, soil samples were also taken from cuts up to 1.80 meters deep for laboratory analysis. In order to highlight the important role of vegetation in the process of soil formation and especially in the formation of humus, the surface phytocomplex and root mass of plants were determined in different seasons of the year. The amount of phytomass was determined once a year during the period of maximum vegetation development (end of May). The determination of the aerial parts of plants was collected 5 times in repetition from 1 m² of area. The grass was cut 2 cm above the soil surface, sunflowers and grapes were harvested, dried in the open air, and then the dry weight was determined. The number of plant species prevailing in the collected herbarium materials was determined. There is no forest cover in the river basin. Water samples were taken with a bathometer in the part of the river Zayamchay, Cehrichay passing through the study area, mineralization and quality analyzes were carried out in the laboratory to determine their suitability for irrigation [21]. Both of them a stormy and abounding river. At each selected site, soil sections were laid down to the depth of the parent rock. In quiet sections, samples were taken for soil analysis (fig. 1, 2). Totally 15 land plots were laid. Some of the physical and chemical parameters characteristics are shown in the following tables (tabl.).

Table

Average indicators of the chemical composition of the soil, %

Soil depth	Humus	P	Na	N	pH	SO ₄	Ca	Mg	Cl
0-16 sm	3.27	0.26	2.35	0.39	7.8	1.895	0.010	0.005	0.32
16-37 sm	2.32	0.22	2.12	0.23	7.9	2.394	0.008	0.002	
37-58 sm	1.81	0.20	2.97	0.37	7.5				
58-77 sm	1.17	0.13	2.13	0.21	7.4	0.167	0.012		
77-118 sm	0.68	0.09	2.18	0.32	7.5				
118-152 sm	0.25	0.11	3.08	0.20	7.3	1.707	0.021	0.004	

In several villages of the Gadabay region, soil samples were taken from soil crops and their physico-chemical properties were studied. The studies were carried out in different seasons of the year both in natural and cultivated cenosis. At the same time, the quality of river water passing through the territory of the Gadabay region and used as irrigation water was studied [5; 7].

Gravitational analysis of water (brief and complete) – E.B. Arinushkina, water-physical properties (hygroscopic moisture) – N.A. Kaczynski; absorbed bases – K.K. Hedroits; carbonates CaCO_3 and CO_2 – with a calcimeter; The content of total nitrogen and humus – Tyurin's method; with pH ionometer-pH meter; ratio C:N – CO_2 according to the Tolubev method [17-21].

Discussion of the results. The most intensive decomposition of the remains of cereal vegetation is observed in the soil of the coastal strip – 65.9%. Such an intense decomposition of the substance can be explained by sufficient aeration of soil horizons and the active oxidization of plant residues by atmospheric oxygen. In the natural cenosis, the destruction rate of saltwort and salt-tolerant grass vegetation reaches 44.3% in the processing of plant residues, the main role is played by a group of saprophages *Hemilepistus* woodlice, which actively drag the plant decay and the decomposed material reaches its final stage of microbiological transformation [12-15].

Carbonization is observed along the profile, starting from the surface of 0-25 cm. The rest of the salts and compounds were washed off the profile. Gray soils are prone to salinization. The soils of these and other territories differ depending on the conditions of soil formation and the natural cenosis. The results of the analysis of seasonal studies of the content of nutrients in dependent particles of irrigation water show that a significant amount of nutrients is introduced to the fields by dependent water particles. This has a positive effect on the fertility of irrigated lands and an increase in their productivity Saratovka, 1340 m above sea level. 250 m east of the gorge southwest gentle undulating slope, rocky pastures [16].

Ca^{+2} and Mg^{+2} in mountain meadow soils gradually increases from the upper horizons 0.010-0.002%, to the lower 0.027-0.004%. The Na^+ content also increases from the upper horizons of 2.27% to the lower ones, amounting to 3.08 %. On the agrocenosis of forage plants, the content of Ca^{+2} and Mg^{+2} cations along the profile is much higher than in virgin soils of the natural cenosis. The total amount of Na^+ and K^+ increases both in the upper horizons and in the lower horizons. In mountain meadow soils of natural and cultivated cenoses, the pH changes between 7.3-7.8.

The following chart shows the percent of humus, dry residue and total salts in mountain meadow soils of Gadabay region (fig. 1, 2).

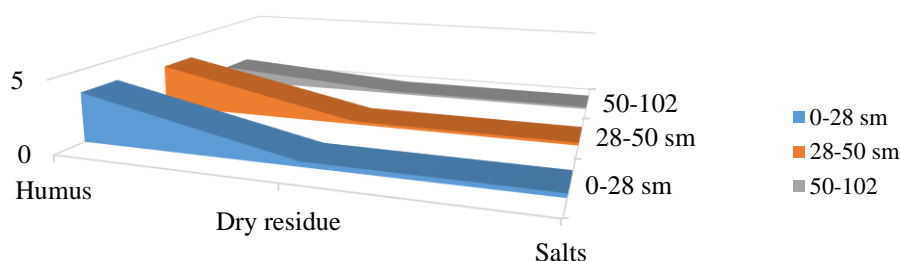


Fig. 1. Change in the content of organic and mineral components depending on the horizon

The activity of the catalase enzyme involved in the oxidation reactions of organic residues in the soil with sagebrush-ephemeral vegetation – 2.30 ml O_2 /g. soil. Indicators of the enzyme invertase gradually increase in biotopes far from populated areas and reach 3.40 mg.gluc./g.soil in 24 hour. Determination in

soil samples of the same biotopes of the activity of another hydrotic enzyme urease involved in the transformation of more complex compounds. if in the soil developing under saline vegetation its indicators (in a 0-30 cm layer) vary between 0.2-0.6 mg, then in the soil under halophyte grass vegetation, the activity of the enzyme increases to 0.4-1.1 mg $\text{NH}_3/\text{g.soil}$ in 24 hour. In general, the hydrolytic activity of invertase and urease enzymes in the studied soils can be assessed as very weak.

The activity of the enzyme was significantly influenced by the growing vegetation, the root system of which and their remains not only improve the soil structure and aerobicity, but also enrich the soil with organic components stimulating biochemical processes and their oxidative-hydrolytic transformation [17-19].



Fig. 2. Points of soil cuts and collected phytomass in the villages of Gadabay region

From 1 kg of soil at a depth of 0-25 cm, 8.2 mg of CO_2 was released, at a depth of 6.8 mg of CO_2 20-50 cm in 1 hour. From a characteristic sample of soil crops laid on dark mountain meadow soils, 14.6 mg/kg.h of CO_2 was isolated from a depth of 0-25 cm, and 11.0 mg/kg.h from a depth of 25-50 cm. In irrigated meadow soils, from a sample taken from a depth of 0-25 cm and from a depth of 25-50 cm, CO_2 was released 17.6 and 11.9 mg/kg.h. As depth increases, the amount of carbon dioxide decreases.

Conclusion. River Cehrichay has 7 tributaries, the self-regulation coefficient is 0.67. The volume of annual imports is 28.000 tons. The degree of mineralization river Zayamchay varies from 140 to 430 mg. The waters of these rivers are irrigation waters, which are dominated by calcium carbonate. In river sediments, the content of absorbed bases does not change in contrast. The content of Mg^{+2} and Ca^{+2} cations is 4.3 mg/ekv and 9.6 mg/ekv. It was revealed that the activity of catalase in natural cenoses of the studied soils varies between 2.03-2.80 ml $\text{O}_2/\text{g.soil}$, invertase 3.80-6.90 mg.gluc./g.soil and urease 2.88 mg. $\text{NH}_3/\text{g.soil}$. A close correlation was found between soil moisture and enzymes (catalase, invertase) respectively, for cenoses 0.59-0.84; 0.66-0.89; and 0.74-0.94; 0.67-0.98 and 0.7-0.80. Average annual humidity 75%, annual precipitation 600-900 mm. The average annual wind speed is 2.2 m/s. Ca^{+2} and Mg^{+2} in mountain meadow soils gradually increases from the upper horizons 0.010% – 0.002%, to the lower 0.027% – 0.004%. The Na^+ content also increases from the upper horizons of 2.27% to the lower ones, amounting to 3.08%. On the agrocenosis of forage plants, the content of Ca^{+2} and Mg^{+2} cations along the profile is much higher than in virgin soils of the natural cenosis. The total amount of Na^+ and K^+ increases both in the upper horizons and in the lower horizons. In mountain meadow soils of natural and cultivated cenoses, the pH changes between 7.3-7.8.

The herbarium was collected and the dominant floristic composition of natural cenosis was determined: *Vicia faba* L., *Taraxacum officinale* F.H. Wigg., *Artemisia vulgaris* L., *Anthemis candidissima*

Willd. ex Spreng., *Veronica vulgaris* Opiz, *Galium tricornutum* Dandy, *Cynodon dactylon* (L.) Pers., *Daucus carota* L., *Trifolium medium* L., *Avena sativa* L., *Apium graveolens* L. and others.

Invertebrates were collected and the dominant composition of the fauna of natural cenoses was determined: *Tettigonidae*, *Hemiptera*, *Cerambycidae*, *Tenebrionidae*, *Coccinellidae*, *Cryllidae*, *Castropoda*, *Arachnidae*, *Alleculidae*, *Diptera*, *Isopoda*, *Lumbricidae*, *Carabidae*, *Curculionidae*, *Lepidoptera* and others.

Therefore, agriculture has a positive effect on soil processes. The roots of vegetables and cereals determine the high productivity of the aboveground mass.

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