ЗЕМЛЕДЕЛИЕ, СЕЛЕКЦИЯ, РАСТЕНИЕВОДСТВО

UOT 631. 46
Orcid id: 0000-0002-5040-2599

MODERN SOIL RESEARCH IN MOUNTAIN FOREST SOILS OF THE LESSER CAUCASUS

HASANOVA TURKAN ALLAHVERDI

Ministry of Science and Education of the Azerbaijan Republic, Baku, Azerbaijan. Az1073

ASGAROVA GUNEL FARHAD

Institute of Soil Science and Agrochemistry, Baku, Azerbaijan. Az1073

(Поступила в редакцию 03.06.2023)

The aim of the research was to obtain new information about the state, main diagnostic features, flora, and properties of the mountain forest soils of the Lesser Caucasus and to determine the taxonomic affiliation of these soils in accordance with the International Soil Classification in accordance with the Soil Resources Database. Since Azerbaijan is a country with little soil, in recent years it has been one of the very topical issues for soil scientists to study the agroecology of soils and vegetation, and the cultivation of environmentally friendly industrial crops. The research area is in the western part of the republic. This zone includes low-mountain and mid-mountain regions of Gadabay, Dashkesan, Goygol, Gazakh, Goranboy, Tovuz, Shamkir, Agstafa regions. As a systematic and scientific innovation of the natural vegetation cover in the study area, the dependence of the amount and group composition of humus in the soil profile on the average annual precipitation and the dependence of the content of absorbed bases in the soil was established. humus was identified for the first time.

Key words. *flora, dominant species, agrochemical properties, irrational grazing.*

Целью исследований было получение новой информации о состоянии, основных диагностических признаках, флоре и свойствах горно-лесных почв Малого Кавказа и определение таксономической принадлежности этих почв в соответствии с Международной классификацией почв и базой данных о почвенных ресурсах. Поскольку Азербайджан является малоземельной страной, в последние годы одним из весьма актуальных вопросов для почвоведов является изучение агроэкологии почв и растительности, выращивание экологически чистых технических культур. Район исследований находится в западной части республики. В эту зону входят низкогорные и среднегорные районы Кедабекского, Дашкесанского, Гейгельского, Газахского, Геранбойского, Товузского, Шамкирского, Агстафинского районов. В качестве систематического и научного новшества в изучении естественного растительного покрова на исследуемой территории была установлена зависимость количества и группового состава гумуса в почвенном профиле от среднегодовой суммы осадков. Впервые была установлена зависимость гумуса от содержания поглощенных оснований в почве.

Ключевые слова: *флора, доминирующие виды, агрохимические свойства, нерациональный выпас.*

Introduction

Use of the soil resources in agriculture affects all the processes in soil and natural landscape. A main problem of the rational use of soil resources is soil protection. It is necessary to note that Azerbaijan has a rare soil genephone. Azerbaijan has 9 out of 11 global climatic zones, which are characterized by the development of unique and endemic soil types. Today's leading area of soil science is the study of the development of modern soil processes. One of the regions of our republic with great economic potential for the development of agriculture is the slopes of the Lesser Caucasus [1, 3, 6].

Research carried out on the soils of the northeastern slopes of the Lesser Caucasus is very important for Azerbaijani soil scientists. Because these soils are highly productive, and if they are properly used in agriculture, a high yield is obtained. Since the emergence of agricultural culture, the general direction of development has been in the direction of obtaining a larger crop from a smaller area by eliminating the factors that limit soil fertility [2, 5].

As a result of unsystematic, non-seasonal, and excessive livestock grazing in the summer pastures located in the mountain-meadow zone of the southern slopes of the Lesser Caucasus, which is the study area, the condition of the meadows and pastures has deteriorated significantly, and the erosion process has intensified. The research area is in the western part of the republic [4, 7, 10]. This zone includes low-mountain and mid-mountain regions of Gadabay, Dashkesan, Goygol, Gazakh, Goranboy, Tovuz, Shamkir, Agstafa regions. Its

total area is 611.9 thousand hectares, which is 7,0 % of the country's territory. Solar radiation, air circulation, and surface cover are considered the area's main climatic factors. The studies carried out that the anthropogenic impact on the land cover due to human economic activity in this province has become increasingly widespread in recent decades. The modern statistical analysis of the physical and chemical soil indicators particular importance from the point of view of the high degree of the territory in terms of increase in the productivity of agricultural plants. Academician G. S. Mammadov notes that modern agriculture cannot be imagined without agrochemicals [8, 9].

The use of special approaches specific to Azerbaijan allowed the establishment of a soil museum based on the laboratory of genesis and geography. It is possible to solve the problem of increasing soil productivity through assessment of its quality, registration, and detailed study of the problems in soil formation.

Object and Methods of Research. The inclined plain with 4041–4120 northern latitude and 4045–4700 eastern longitude is in the western part of the intermountain Kur-Araks depression from the place where the Khram river flows into the Kur river-near the city Mingachevir at the intersection of the southern slope of mountains. The relief-inclined plain is separated into dominant denudation and accumulative forms.

The soils of the studied territories are represented mainly by mesophilic forests, xerophilic forests, and mountain forest soils formed under shrubs. The modern soil-ecological conditions of the Lesser Caucasus were studied, and several field and operator works were carried out. Studied the important role of vegetation in the process of soil formation and especially in the formation of humus, the surface phytocomplex, and the root mass of plants were determined in different seasons of the year. The amount of phytomass was determined during the period of maximum vegetation development (the second decade of May and the first decade of June). The determination of the aerial parts of plants was collected from 1 m^2 and 2 m^2 of area. To highlight the important role of vegetation in the process the several plant species prevailing in the collected herbarium materials were determined. The amount of root mass was studied based on a monolithic method (25 × 25 cm) 3 times at a depth of 0–25, and 25–55 cm with plant species prevailing in the collected herbarium materials. Samples were taken from certain areas for soil analysis. Water-physical properties (hygroscopic moisture) – N. A. Kaczynski; absorbed bases – K. K. Hedroits; the content of total nitrogen and humus – according to Tyurin; using a pH-ionometer. The study held the main life of rare species analysis of forms in the flora according to the system of I.Q. Serebryakov.

Results

As a result of our research in the Ganja-Gazakh zone of the Lesser Caucasus, it was found that the soils common here are heavy loamy and loamy in their granulometric composition. It is also favorable for the development of plant roots, the normal movement of water and air. In the middle part of the profile, the accumulation of particles of silt and physical clay was observed. The amount of easily hydrolyzable nitrogen, mobile phosphorus, and exchangeable potassium in the upper layers is 72.1, respectively; 15.4 and 316.3 mg/kg. The change in the distribution of humus along the profile, depending on the content of absorbed bases, determined by a complete analysis of soil water content, is shown in the graphs below. (Fig.1, 3)

The monitoring conducted in the region in 2019–2023 indicates that the environmental indicators and chemical and biological properties of soils in deforestation zones have undergone fundamental changes. Natural vegetation in areas of the territory is subject to anthropogenic impacts, and the number of valuable plant species is reduced or destroyed. It gradually negatively affects the ecosystem showing its effect. Natural dominant species in studied area: Aceraceae Juss., Apiaceae Lindl., Axteraceae Dumort, Brasxicaceae Burnett, Caryophyllaceae Juss., Chenopodiaceae Vent., Axplenlaceae Newm, Anacardiaceae Lindl., Dipsacaceae Juss., Convolvulaceae Juss., Euphorbiaceae Juss., Fabaceae Lindl., Gentianaceae Juss., Cyperaceae Juss., Papaveraceae Juss., Poaceae Barnhart, Papaveraceae Juss., Polygonaceae Juss., Pyrolaceae Dumort., Rhamnaceae Juss., Rosaceae Juss., Rubiaceae Juss., Salicaceae Mirb., Saxifragaceae Juss., Scrophulariaceae Juss., Solanaceae Juss., Orchidaceae Lindl., Malvaceae Juss., Melanthlaceae Batsch, Liliaceae Juss., Tamaricaceae Lindl., Ranuneulaceae L., Violaceae Batsch, Vitaceae Juss.

New ranges of variations of several species named below were discovered by us for the first time. Endemic plant species of the study area: Aphanopleura zangelanica Goghina et Matz., Allium dictyoprasum C. A. Mey.ex Kunth., Allium.egorovae M. V.Agap.et Ogan., Allium kunthianum Vved., Allium leucanthum C.Koch., Allium maria Bordz., Allium szovitsil Regel., Astragalus brachypetalus Trautv., Astragalus caspicus Bieb., Astragalusflnitimus Bunge., Acantholimon tenuflorum Boiss., Pistacia mutica Fisch.et C. A. Mey., Carthamus oxyacanthus Bieb., Cirsium aduncum Fisch.et C. A.Mey., Cirsium elodes Bieb., Cirsium rhizocephalum C. A. Mey., Cirsium szovitsii (C. Koch) Boiss., Cousinia cynaroides (Bieb) C. A. Mey., Cachrys microcarpa Bieb., Carum komarovii Kaijag., Hieracium cincinnatum Fries., Hieracium rubrobauhini (Schelk.et Zahn) Juxip., Hieracium sericicaule (Schelk.et zahn) Juxip., Malabaila sulcata Boiss., Peucedanumpauciradiatum Tamamsch., Jurinea grossheimii Sosn.

The systematic composition of rare and endangered species found in the areas of the study area is shown below (Table 1.).

Table 1. **Systematic composition of higher taxa of rare plants**

Higher taxa	Group		Species	
	Number	%	Number	%
Gymnospermae	2	5.34	3	2.90
Angiospermae	43	94.66	97	97.10
Dicotyledoneae	32	–	83	–
Monocotyledonae	9	–	13	–
Totally	44	100	99	100

We found that the amount of humus in the soil taken from the cut areas is 1.5–2 times less than in the soil under the forest. A minority of major constituents in the soil is indicative of future environmental issues and soil degradation in the area. During environmental monitoring, the current ecological and geographical position of the region was established. The protection of soil profiles and the implementation of successful reforestation activities can greatly affect the balance of chemical compounds and the amount of organic matter in the soil.

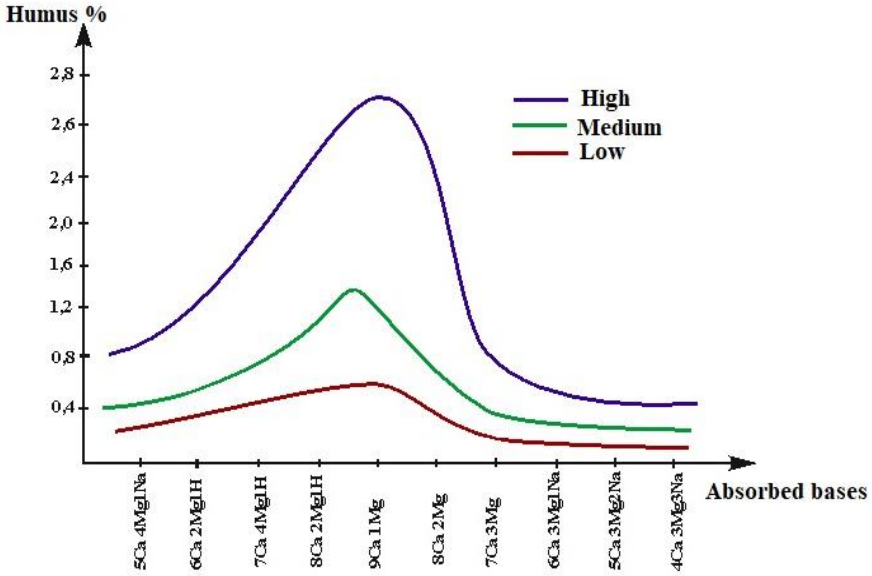

Fig. 1. Dependence of the amount of humus on the absorbed bases

The relationship between the distribution of humus in the soil profile and the average annual precipitation is shown in the graph below. (Fig.2). As can be seen, the optimal amount of precipitation and the amount of humus in arable soils are directly proportional.

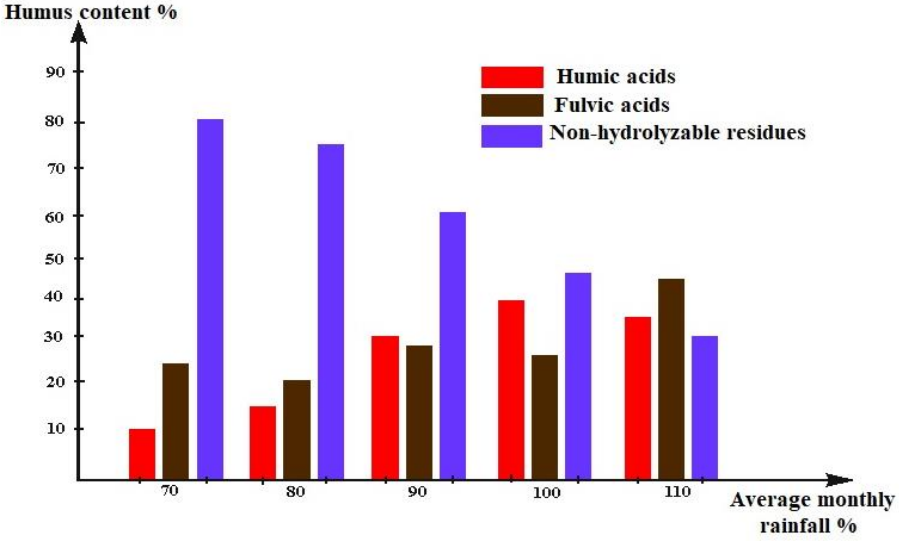

Fig. 2. Changes in the group composition of humus depending on the amount of precipitation

Mineralization of the river waters is weak – a total quantity of quickly dissolving salts doesn't reach 1 gr/l in the inclined plain. Turbidity of the river waters in the Ganja-Gazakh inclined plain changes by 140–239 g/m^3, and this is less than 4–14 times from turbidity of the Kur River. The groundwaters are in the deep layer and don't directly participate in the soil-forming process. The vegetation consists of a group of white grasses, wormwood, and white grass, various ephemerids, ephemerals treelike shrubs are characteristic.

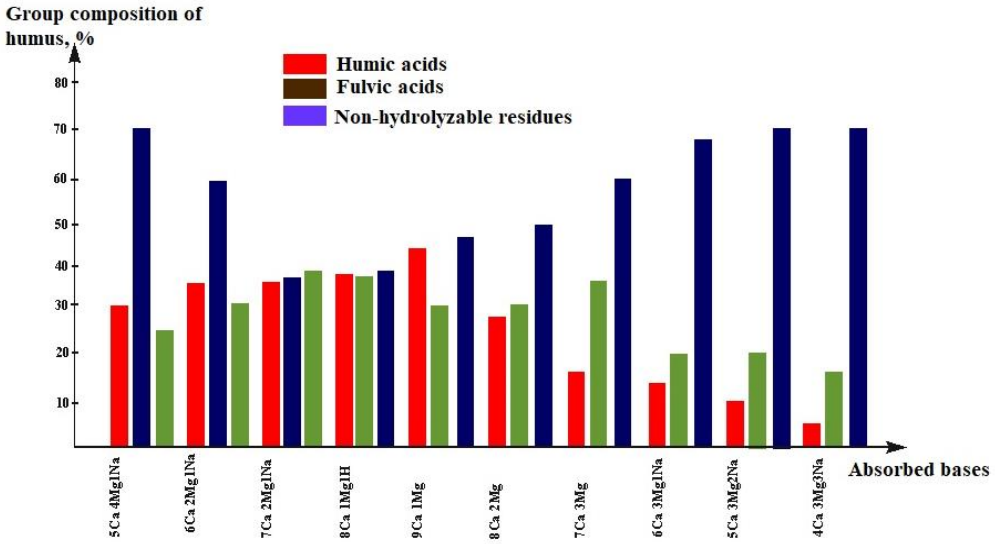

Fig. 3. Dependence of the group composition of humus on absorbed bases

The study of qualitative and quantitative indicators of soils is of great importance in their environmental assessment. The main environmental indicators are absorbed bases, pH, hygroscopic and total humidity, soil temperature, moisture capacity, and natural vegetation (Table 2).

Table 2. **Some main agrochemical properties of selected soil profiles**

Horizons, sm	Absorb. Ca %	Absorb. Mg %	Humus %	pH soil: water 1:5 extract	Hygroscopic moisture %
Profile No. 131					
0–21	50.5	11	10.3	6.75	6.279
21–40	51.4	7.6	8.1	7.04	6.092
40–63	41.9	3.1	4.0	7.36	4.933
63–88	30.3	5.7	2.3	7.67	3.132
88–110	32	11.5	2.1	7.85	2.893
Profile No. 146					
0–21	41.3	8.2	7.9	5.61	5.412
21–42	41.2	8.3	3.8	5.90	5.904
42–73	47.2	9.8	2.3	6.27	6.054
73–96	52.2	8.3	1.1	6.42	6.683
96–122	51.6	4.9	0.9	7.50	4.110
Profile No. 198					
0–12	32.2	9.8	10.4	5.64	4.892
12–26	33.6	6.4	15.5	5.92	2.899
26–58	37.7	24.3	17.8	5.94	4.141
58–85	38.7	15.3	19.8	5.96	4.913
85–116	34.2	16.8	18.7	6.00	4.939
Profile No. 216					
0–15	29.7	6.3	6.54	7.36	3.213
15–33	24	5.5	1.92	7.70	2.95
33–80	21.6	6.9	0.35	7.90	2.428
Profile No. 247					
3–22	14.8	5.7	6.38	5.46	7.335
22–58	35.9	4.1	2.24	5.20	4.756
58–86	35.9	14.6	1.65	5.96	4.197
86–105	43.8	3.7	1.32	6.02	5.874
105–118	36.3	8.7	1.38	6.14	5.227

Conclusion

When compared with literary materials, we observe a weakening of the agrochemical properties of soils as a result of irrational grazing, the use of plant stems as fuel and increased erosion processes. Being such a fuel plant as saxaul, it is advisable to protect it in order to preserve its gene pool. Considering all this, it was included in the Red Book of Azerbaijan. Based on the analysis of comparative geographic and laboratory results, changes in the diagnostic parameters of brown mountain forest soils as a result of the influence of various anthropogenic processes were studied. Due to both erosional processes and the intensive involvement of these soils in crop rotation, a decrease in the amount of accumulative putrefactive layer, humus and nitrogen, absorptive capacity, and lightening of the granulometric composition was established.

REFERENCES

1. Asgarova, G. F., Hasanova T. A. 2022 Significance impact of grazing on soil properties in Azerbaijan. Advances in Science and Technology. XLV İnternational Scientific-Practical conference. Research and Publishing Center Actualnost. RF., Moscow, Russia, June 15. pp. 12–14.

2. Babayev, M. P., Ismayilov A. I., Huseynova S. M. (2017). Integration of the Azerbaijani national soil classification into the international system. Elm, Baku. 272 p.

3. IUSS Working Group WRB. World Reference Base for Soil Resources (2014). International soil classification system for naming soil and creating legends for soil maps. World Soil Resources Reports No. 106. FAO, Rome, 181 p.

4. FAO. (2015) World reference base for soil resources 2014/ International soil classification system for naming soils and creating legends for soil maps Update 2015. 192 p.

5. Hasanova, T. A. (2015) Complexes (Ecogroups) of the invertebrates, phytomass and dinamics of microbiological population and their importance at grey-brown soils diagnostics in Azerbaijan. Universal Journal of Agricultural Researches, Volume 3 Number 4. Horizon Researches Publishing, USA. pp. 130–135 https://www.hrpub.org/20150620/ujar3-10403811

6. Hasanova, T. A., Mammadova G. I, Gahramanova A. Y., Bunyatova L. N. (2021). Importance of biodiagnostics and irrigation grey-brown soils. Universal Journal of Agricultural Research. Horizon research publishing co., ltd. ISSN: 2332-2268. DOI: 10.13189/ujar. 090301 Volume 9, No3. pp. 63-69 USA, CA https://www.hrpub.org/journals/article_info.php?aid=11006

7. Hasanova, T. A., Asgarova G. F. (2021) Phytomass of Gray-brown Soils Forming in Arid Ecosystem of Azerbaijan. Bulletin of Science and Practice Scientific Journal Publishing Center Science and Practice. Nizhnevartovsk, Russia. Volume 7 Issue 9 pp. 110–115 https://doi.org/10.33619/2414-2948/70.

8. Mamedov, G. Sh., Babaev M. P., Ismailov A. I. (2002). Correlation of Azerbaijan soil classification with the WRB system. Elm, Baku. 252 p.

9. Nasirova, A. İ., Alieva M. M., Mammadova R. N., Hasanova T. A. (2022). Ecological edificators of gray-brown soils in Ganja-Gazakh massif (Azerbaijan). Environment and Ecology Research journal. USA CA. DOI: 10.13189/eer.2022.100307 Volume 10 / Number 3. pp. 120–134 https://www.hrpub.org/journals/article_info.php?aid=12233.

10. World reference base for soil resources (2014) International soil classification system for naming soils and creating legends for soil maps Update 2015, 2017. Translated by I. A. Spiridonova; Ed. M. I. Gerasimova and P. V. Krasilnikov. FAO/ Moscow State University named after M.V. Lomonosov, Moscow. 203 p.