Abstract.
Comprehensive studies have been carried out on some physico-chemical indicators of mountain-forest brown soil. The humus content, carbonate content, and pH of soil samples selected from natural biotopes and cereal agrocenosis were comparatively determined. The dynamics of changes in these indicators for individual layers of the studied cenoses was established and characteristic differences were analyzed. Physico-chemical analyzes of soil samples from natural and cultivated biotopes of mountain-forest brown soil showed some differences between them. It has been established that the total humus content in natural cenoses varies in individual layers, respectively, between 2.48-1.91% and 5.85-3.1%. In grain agrocenoses, this indicator varies between 3.13-2.25%. The reaction of the aqueous solution of soil samples from different cenoses varies respectively between 7.31-7.61; 7.65-7.82; and 7.54-7.68-7.94. Similarly, in these cenoses the carbonate content also varies within the range from 11.93-20.15%. The amount of absorbed bases was 39.08 mg.eq. in the layer 0-25 cm, 38.76 mg.eq. in the layer 22-37 cm and 38.86 mg.eq. in the layer 37-90 cm and gradually increased to 46.10 mg.eq. The conducted soil studies can be used as literary material for the protection of soil resources in Azerbaijan, improvement of the current ecological state of lands used in agriculture, and environmental assessment.

Keywords:
absorbed bases
carbonates
biotope
Introduction. The studied mountain-forest brown soils are widespread in the dry forests of Azerbaijan. The phytostucture is represented by sparse oak and hornbeam forests, as well as forest and shrub plantations. Well-developed undergrowth consisting of hawthorn and grass cover. The litter horizon is 1-2 cm thick, has a loose structure and consists of weakly decomposed leaf litter. The humus horizon is 15-28 cm thick, has a nutty-granular structure. The horizon contains a lot of root remains of herbaceous and woody vegetation. The horizon is biologically well cultivated; there are earthworm tunnels and coprolites. The climatic conditions of forests and shrubs are close to the Mediterranean climate. Characterized by hot summers, long warm autumns and moderate winters. The average annual temperature is 8.4-10.8°C. In the processes of development of these soils, a two-phase biological cycle in soil formation is manifested. The active phase is long and covers the spring and autumn phases. The pause period is shorter and is confined to the hot summer months (July-August). The average annual precipitation varies between 450-600 mm. The dryness index varies within 1.5-2.0. The sum of active temperatures of atmospheric air (˃10°C) is 3400-4000°C, and the soil is 3500-5000°C. There is a slight weakening of the biological activity of soils in the winter months, at low positive temperatures of the soil cover [1, 2, 3]. Each of the indicated phases of soil formation is combined with certain elementary processes. For example, in the active phase of biological activity, intensive humus accumulation and the formation of weakly condensed newly formed substances, intensive weathering and the formation of secondary clay minerals occur. However, during the pause period, the precipitation of carbonates, the formation of a carbonate horizon, and intensive polymerization of humic substances are noted [4, 6]. The development of these soils on the carbonate weathering crust caused their high saturation with bases. Therefore, as a rule, brown soils are characterized by a neutral or slightly alkaline reaction in the upper horizons, and with depth along the profile. The pH is clearly alkaline. All these features of soil formation conditions are reflected in the morphological state of the soil. They are characterized by an extended humus profile, high clay content of the horizon,
good aggregation and clear expression of the carbonate horizon [5]. From a landscape point of view, there is a distribution of walled brown soils in the dry forest zone. They are often confined to forest clearings or distributed in small areas under sparse forests and shrubs. The most powerful factor determining the development of the process of settling down is human economic activity. It has now been established that brown soils are widespread in Azerbaijan’s lower, relatively arid belt of dry forests and shrubs.

**Methods.** The studies were carried out on typical mountain-forest brown soils. The objects of study were a forest biotope under tree-shrub and herbaceous (bluegrass, fescue, clover) vegetation, a virgin biotope under natural grass stand and grain agrocenoses. On selected natural and cultivated cenoses, soil samples were taken from 0-10 cm; 10-20cm; 20-30cm layers to determine some physical and chemical parameters. The soil score is 85 points. Soil-forming rocks are products of weathering of eluvial-promovial materials, carbonate loams. Taxonomic indicators of the studied typical mountain-forest brown soils are given on the basis of fundamental research on the systematics and classification of soils in Azerbaijan [7]. These data will provide the need for a scientific basis for our subsequent research. Physico-chemical analyzes were carried out comprehensively based on the methods of E.V. Arinushkina [2].

![Figure 1](image_url)

**Figure 1**

A range of contrasting soil profiles
Results. The humus horizon of typical mountain-forest brown soils is 15–28 cm thick, has a brown color, and a nutty-lumpy structure. The distribution of humus along the profile is quite uniform, which is manifested in its significant decrease with depth, sometimes at a depth of 90–110 cm the amount of humus reaches 0.8–1.1%. The results we obtained also show their gradual decrease in layers (010; 10–20; 20–30 cm), both in natural cenoses between 2.48–2.12–1.91%, in forest cenoses from 3.1% to 5.20–5.84%. In agrocnoses under grain crops, the amount of humus compared to virgin cenoses due to agrochemical (fertilizer) measures increases by 1.17–1.26 times to 2.24–2.71–3.13%. The composition of humus is fulvate-humate. The positive impact of agricultural technology and applied organic fertilizers – manure, biocompost on crop yields. The humid content and fertility of various types of soils were also indicated in literary sources. The reaction of the soil environment has a significant influence on the activity of biological processes. The analysis showed that the reaction of the soil solution from various horizons (0–10; 10–20; 20–30) of natural and cultivated cenoses is close to neutral and slightly alkaline. In forest biotopes, pH values varied between 7.6–7.8. In grain agrocnoses, it was slightly alkaline 7.54–7.93, which is associated with irrigation and the technological processes carried out. Comparing the data we received with literary sources, sufficient closeness between them. The mountain-forest brown soils we studied are saturated with carbonates 7.68–20.15%, the main part of which is localized in the middle and lower horizons. Due to the fact that clay components significantly contain montmorillonite, the absorption capacity of these soils reaches 31.3–39.7 mg/eq.100g. soil. Forest soils and their stepped variants are characterized by a high and medium content of water-stable aggregates. Arable forest soils are often significantly dispersed due to low agricultural practices in the recent past. This leads to the fact that dust (fraction <0.25 mm) appears in the arable layers during late cultivation, the amount of which in the middle layers ranges from 1.71 to 1.83%, and in the upper soil layer reaches 12.1%. The name of mountain brown soils according to the international classification based on a reference database (WRB) in 2015: 1. Chernic Luvic Vermic Endogleyic Kastanozems,
2. Humic Luvic Anthric Kastanozems. 3. Calcic Kastanozems. 4. Hidragric, Humic, Anthric Kastanozems. Physico-chemical analyzes of soil samples from natural and cultivated biotopes of mountain-forest brown soil showed some differences between them. It has been established that the total humus content in natural cenoses varies in individual layers (0-10; 10-20; 20-30 cm), between 2.48-1.91% and 5.84-3.0%. In soils under agrocenoses, this figure varies between 3.1-2.24%. The reaction of the aqueous solution of soil samples from different cenoses varies accordingly between 7.31-7.82. Similarly, in these cenoses the carbonate content also varies within the range of 7.68-20.15%. In meadows, 92.9% of the soil cover was subject to moderate, 3% severe and 4.2% very severe degradation. The amount of absorbed bases was 39.08 mg.eq. in 0-25 cm layer, 38.76 mg.eq. in 22-36 cm layer and 38.86 mg.eq. in 36-89 cm layer and gradually increased to 46.10 mg. eq. Our studies of the macrostructural composition of forest soils allow us to come to the conclusion: in arable soils, the number of water-stable aggregates is significantly reduced, amounting to 79.74%. In the subarable layers of arable land, the content of water-resistant aggregates larger than 0.26 mm increases slightly, reaching 89.33%, which is inferior to the corresponding indicator for virgin soil (92.81%). The results of the study of mountain forest soils of the Azerbaijan Republic give grounds to recommend agrotechnical and soil protection measures aimed at maintaining, preserving, and, if necessary, recreating the soil structure as a condition for improving the productivity and yield of agricultural crops.
Figure 3

Organic matter in forest and prairie soils

References:


