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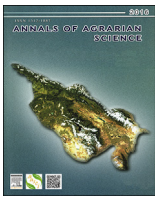

Current state of humus in irrigated meadow-brown soils in the Republic of Armenia

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ABSTRACT

Irrigated meadow-brown soils of the Ararat valley of the Republic of Armenia have been studied. It has been shown that they are characterized by low humus content, quite rapidly decreasing with depth, and the fulvo-humate and humate types of humus, the significant content of strongly bounded humin acids and the low content of mobile forms, the comparatively equal distribution of humin acids within the bounds of genetic profile. It has been noted that long-term use of these soils brings to the reduction of humus and non-hydrolysable residue.

The Republic of Armenia is a typical land-poor mountainous country, for whose agriculture the problem of soil degradation caused both by natural and, mainly, anthropogenic factors are quite topical. Despite the fact that the negative changes taking place in the soils are very diverse, the changes of the composition of humus in soils, having, apparently, the most significant impact on the soil fertility and crops productivity are considered as the most important of them, in particular, for the irrigated meadow-brown soils of the republic.

The present work is devoted to the study of the changes taking place in the composition of humus of the irrigated meadow-brown soils in the Republic of Armenia as a result of their intensive use under the conditions of the global climate change.

The studies have been conducted in a number of areas of the Ararat valley, a comparative study of the arable land have been also conducted.

The field studies have been carried out according to the commonly accepted methods of the field soil survey, and the laboratory studies have been conducted according to the methods being traditional for the soil science. The content of humus has been determined by Tyurin method and the composition of humus has been determined by the method of Kononova and Belchikova [1].

The irrigated meadow-brown soils occupy the lowest-lying inclined-flat part of the Ararat hollow within the heights of 800–950 m above the sea level. The Ararat plain, occupying a lower part of the storage reservoir of the middle course of the Arax River, in essence, serves as an area of discharge of waters flowing from all the parts of the hollow. The plain is located in the most arid part of the semi-desert zone, is distinguished with its dry and sharply continental climate with cold winters with little snow and dry hot summers. Due to the complex lithological and hydrological conditions of the plain, the subterranean and deep waters within its bounds are at different depths and have different chemical composition and degree of mineralization.

The irrigated meadow-brown soils are mainly developing under the conditions of quite a long-term century-old process of irrigation and semi-hydromorphic and automorphic moisture. The initial soil formation in the given territory took place under the conditions of capillary-soil moisture, but much later, the subterranean waters and the capillary selvedge came off the soil layer and the soil formation proceeded under the automorphic conditions and under the influence of irrigation. As far as the intensive artificial irrigation has been used, exceeding a few dozen times the atmospheric moisture, the sediments on the top became enriched with agricultural-irrigation alluviums, simultaneously being subjected to the eluvial process at a considerable depth. These processes

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together with the agro-genetic methods of impact (fertilization, grass cultivation and cultivation of other field crops) led to the formation of quite deeply humusized (70–90 cm) but weakly differentiated soils.

According to the system of indices of humus soils state by Grishina and Orlova [2], the irrigated meadow-brown soils are characterized by the low content of humus in the upper horizons (1.41–4.48% of the weight of the soil) and very low - in the following horizons (0.48–1.38%) (Figs. 1 and 2). In the composition of humus of the meadow-brown soils throughout the whole profile the humin acids (HA) prevail over the fulvo acids (FA). The HA content within the profile varies from 13.6 to 39.5% and the FA content - from 12.0 to 33.7% of the carbon (C) of the soil.

The ratio of C_{ha}: C_{fa} made 1.04–2.45, which characterizes the fulvo-humate and humate types of humus [3–5]. The exceptions were the meadow-brown soils of section 5 (Armavir), in the upper horizon (As) of which FA prevail over HA, and the ratio of C_{ha}: C_{fa} is equal to 0.77. Such a composition is quite understandable by the increased mineralization of humus of the upper layer of the soil under the annual crops. In the deeper layers of this section, as in other studied soils, the humus type is fulvo-humate (C_{ha}: C_{fa} = 1.48–2.45) [6,7].

In contrast to the irrigated meadow-brown soils, in the composition of humus of the meadow-bog soils HA prevail over FA quite slightly only in the upper horizon, where C_{ha}: C_{fa} makes 1.04. The content of HA sharply falls with the depth, and the ratio of C_{ha}: C_{fa} sharply decreases (up to 0.41 – section 3) [8,9].

Considering HA distribution in the soils profiles, it should be noted that in the studied soils the general content of HA mainly increases with depth. It indicates at the movement of HA in the carbonate environment of the irrigated meadow-brown soils, as a result of which the ratio of C_{ha}: C_{fa} decreases in deeper layers.

Earlier it has been set that the reaction of the irrigated meadow-brown soils is alkaline (pH 8.2–9.0), and Ca makes the greatest

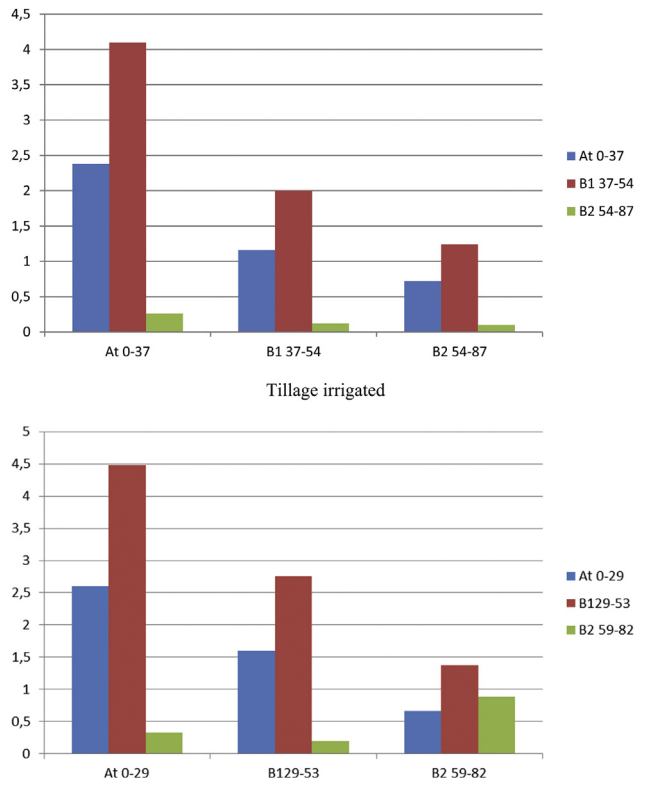

Fig. 1. Humus content in irrigated meadow-brown soils (Echmiadzin).

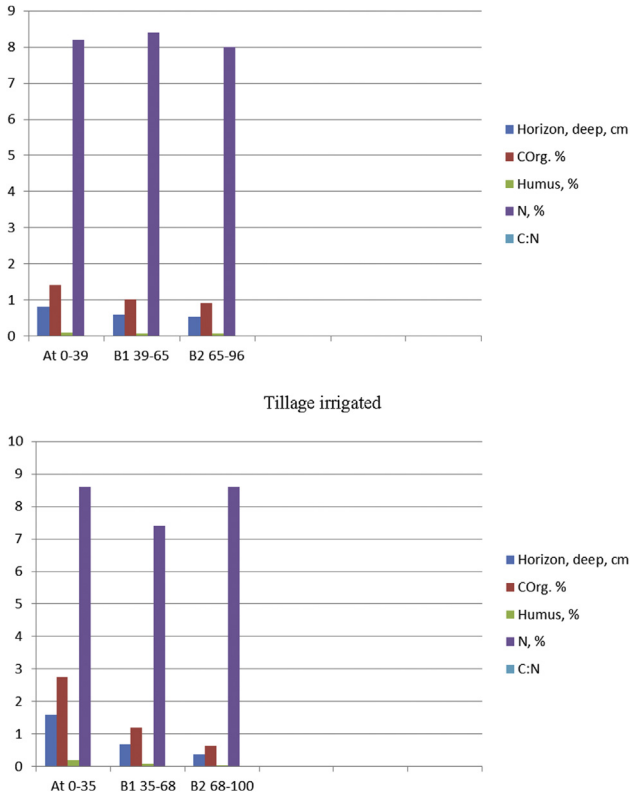

Fig. 2. Humus content in irrigated meadow-brown soils (Armavir).

share of the amount of the absorbed bases [10]. In this connection, in the fractional content of HA, HA-2 connected with Ca prevails, making 3.6–33.9% of the total number of the carbon of HA within the bounds of the profile. The fraction of strongly bounded HA-3 makes a significant share in the carbon balance of HA, i.e. - from 3.4 up to 15.8% (Figs. 3 and 4) [11,12].

The studies have shown that brown HA (HA-1), free and associated with the mobile forms R_2O_3 [high-class oxides] in the meadow-brown soils are present only in the upper horizon (Ap), and their number does not exceed 2.4% of C soil and makes 2.4–8.0% of the amount of HA. A slight increase in the proportion of HA-1 in the humus horizon and their deeper spread (in horizon B) are observed while using these soils under the annual crops.

The fraction FA-1a is absent in the content of FA, and FA-2 and FA-3, which are in the polymer complex with HA-2 and HA-3, prevail (Figs. 5 and 6).

The meadow-bog soil is characterized by the complete absence of HA-1. Besides that in the fractional composition of HA Ca humates (HA-2) prevail over HA-3 only in the upper horizon, and the share of firmly bounded HA-3 (50–80% of the amount of HA) increases with depth. This phenomenon can be explained by the presence of a great quantity of movable R_2O_3 and, primarily, Fe_2O_3 [13–15].

Insoluble residue content in soils is relatively high; it makes 36.9–67.6% of the total C of the soil.

It should be mentioned that the comparison of the soils, which have been irrigated comparatively recently, with the old-irrigated variants, shows a noticeable decrease of the content of humus. So, the data of the Table shows that the humus content in the arable layer of “new” - and “old” –irrigated soils makes 2.76% and 1.41%, respectively [16].

Thus, the studied irrigated meadow-brown soils are characterized by the low content of humus, quite rapidly decreasing with

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