

BLACK SOILS DEGRADATION IN THE SOUTH-WESTERN BLACK SEA REGION AT IRRIGATION AND IN THE POST-IRRIGATION PERIOD

Bilanchyn Yaroslav^a, Rezvaya Svetlana^{a*}, Medinets Volodymyr^a

^a*Odessa National I. I. Mechnikov University, 2 Dvorianskaya str., Odessa, 65082, Ukraine*

**e-mail: grunt.onu@mail.ru*

Abstract: many years' studies of process of changes in composition, properties and fertility of the black soils of the North-Western Black Sea area in Ukraine with irrigation have revealed mobility of carbonates and humus in them, decrease of capacity of cationic consumption and content of consumed calcium, increase of share of consumed magnesium and sodium. Indicators of agro-physical state of soils under irrigation conditions are worsening significantly. In the last 15-20 years, due to sharp decrease in area of irrigated fields an extensification of agriculture the display of agro-physical solonetzicity of previously irrigated lands is strengthening, as well as processes of their dehumification; indicators of ecological&agrochemical state are degrading. Substantiated is the system or agro-amelioration measures aimed to prevent from degradation processes of irrigated black soil missives and increase their fertility.

Key words: black soils, irrigation, post-irrigation period, degradation processes.

Introduction

South-Western Black Sea region with high resources of sun warmth and potentially highly fertile black soils suffers insufficiency and non-stability of atmospheric precipitation and in the last decades – growth of weather aridness and increase of temperature in summer and autumn months. Only irrigation could be a reliable means of agriculture intensification in the region and decrease of its dependence upon unfavourable weather conditions. In 1960-1990 here were the periods of wide-scale irrigational development and regular irrigation of lands, both black soils southern and black soils common. In the last 15-20 years area of regular irrigation in the region decreased sharply (5-8 times). At that, significantly decreased input into the fields of irrigated massive of organic and mineral fertilizers, chemical ameliorants, pesticides and herbicides. As the black soils are very sensitive to the influence of irrigative water and differ with increased selectivity to Na-ions consumption, significant change is stated in changes of composition and property of these soils both during irrigation and during current post-irrigation period of their evolution on the background of decrease of agro-amelioration culture and extensivication of agriculture [1-3]. More often the changes of degradation direction taking place, and measures must be grounded and elaborated for protection and sustainable use of those highly fertile soils.

The objective of the paper is to reveal the essence and ecological & soil consequences of degradation processes of South-Western Black Sea Black soils during irrigation and in the current post-irrigation period of their evolution, development of measures to prevent degradation processes in irrigated massive and to increase their fertility.

Organization and Performance of Work and Researches

Studies of essence, spatial regularities and ecological & soil consequences of processes of North-Western Black Sea black soils' changes at irrigation and in the current post-irrigation period of their evolution, beginning from 1971, are carried out on the stationary plots for soil monitoring and irrigated massive monitoring in Odessa Region. The plots differ in their landscape & geochemical and soil & agro-amelioration conditions, duration and intensity of irrigation, quality of irrigation waters, duration of the period of post-irrigation landscape and black soils' evolution in the last 15-20 years. In parallel similar soil monitoring studies were carried out on the adjacent bogharic (non-irrigated) lands. Every year density of consistence is determined, and in the selected samples – pH, grain size, structural & aggregate and micro-aggregate composition, salinization and carbonate content, content and composition of absorbed bases, total and active fluorine, as well as NPK forms available for plants. In the samples of irrigation and drainage waters pH, ions composition, mineralization, content of different NPK forms and fluorine were determined. Stock of yields' sizes is taken. Since 2010, in experimental & production conditions, agro-ameliorative efficiency of measures developed by us to prevent black soils degradation in irrigated massive, liquidate unfavourable soil conditions-soil & ecological consequences of irrigation and increase of fertility are studied.

Main Results of Studies and their Discussion

With the beginning of irrigation in the region, mainly on plain watersheds and high river terraces, conditions of functioning of all components of nature-geographic environment changed, as well as the established in centuries scheme of landscape and geochemical junction. Our studies of many years (1971-2011) have established that under the influence of irrigation main characteristics and indicators of source state of natural- and soil-ameliorative environment change

significantly, direction and intensity of landscape & geochemical and soil-forming processes. As the result, landscape & ecological situation change in general – composition, properties of soils, often structure of soil cover of the territory of irrigated massive. At that landscape & geochemical and soil-forming processes could have reversible, partially reversible or irreversible character (usually of *degradation* direction) [1-3]. Among negative events and processes are; rising of under-soil waters to the surface, activation on local and regional levels of galo-geochemical processes. Practically everywhere the consequences of irrigation are increase in soils of mobility of carbonates and humus substances, decrease of capacity of cationic exchange and content of consumed calcium. The share of consumed magnesium and sodium grow which evidences of alkalization and salinization processes of black soils with irrigation. At that, significantly degrade indications of their agro-physical state as the result of processes of aggregates destroying – incrustation, increase of density and hardness, decrease of permeability, increase of hydrophilicity of irrigated soils. More intensive degradation in initially non-carbonate black soils at irrigation with low-quality waters with high mineralization (1-3, sometimes 4-5 g/dm³) of sodium & magnesium chemical properties. Significantly less change at irrigation parameters of black soils in case if they are carbonate, with no-deficit balance of humus and calcium, at careful regimes of irrigation with good quality waters, as well as at observance of corresponding culture of irrigated agriculture.

In conditions of significant decrease in the last 15-20 years of area and intensity of irrigation in the region there is evident tendency to eventual re-naturalization of landscape & ecological and soil & amelioration situation on massive of irrigation, re-gradation soils changed by irrigation in the previous years, black soils first of all. Eventual change of agricultural & amelioration conditions on irrigation massive entail changes and certain difficulties with existing nature & economic and agro-amelioration and soil situation. On this background it is stated that new landscape & geochemical and soil-formation processes of previous period of large-scale irrigation develop, or their essence transform. Correspondingly, characteristics of soils state eventually change. First of all, those are salt characteristics of black soils of irrigation massive, composition of soil solution and soil adsorption complex (SAC), and largely – parameters of humus and agro-physical state. In particular, in soil massive on watersheds elution of salts from upper horizons of profile grow. At the same time the soil depth of geochemically subordinated landscapes differ with higher content of easily-soluble salts. In upper horizons of black soils after irrigation had stopped content of soluble and absorbed sodium decreased. At that the share of calcium in SAC grows. In lower horizons of black soils, especially those which were irrigated in past years with highly mineralized water of sodium chemical properties, ratio $Ca^{2+}:Na^+$ stays narrow (0,3-0,6) and content of exchangeable sodium is quite high (up to 3-6% of capacity of cationic exchange). At the background of desalination – dealkalinisation of black soil irrigated massive in post-irrigation period of their evolution the indicators of agro-physical state eventually improve. Tendency to decompactization is observed, quantity of blocky aggregates decreases, share of agronomic valuable aggregates and coefficient of soil pedality. Speed of agro-physical properties degradation is significantly higher in soils, which were previously irrigated with good quality (fresh) water.

In the last 20 years under both under bogharic conditions and in irrigated massive of the region humusness of soils eventually go down. I.e. process of dehumification of studied soils take place. The reason of this very unfavourable degradation process is domination of grain and sunflower in crop structure without application of necessary quantities of organic and mineral fertilizers. Only under perennial grasses, starting with 2nd year of cultivation, content and amount of humus grow, which enables us to recommend increase of grasses share up to 25-35% of area in the structure of crop rotation.

Thus, based on experimental & research materials, both our and other authors' it is revealed that irrigation of the South-Western Black Sea black soils cause significant changes (most often negative) in soil natural regimes and processes, and connected with them morphological indicators, soil composition and properties. Tendency of degradation of many soil parameters is preserved in current post-irrigation period of evolution of landscapes and soils of irrigated massive. Most often, as it was pointed out above, processes of decarbonization and irrigation salinization take place, and locally – salting of soils, degradation of their humus and agro-physical state, supply of nutrients for plants. Usually these degradation changes of the indicators of state and properties of soils reveal simultaneously [1-3]. Taking into account size of values of salinization, salting of soils and alkalization of black soils of irrigated massive, their humus and agro-physical state, pollution with heavy metals and water-soluble fluorine, recently an integral classification of soils according to the level of their degradation had been proposed [2, 3]. At that, it had been established that at low level of soil degradation in irrigated massive crop yields decrease 15-20%, at medium level – 20-30%, at high level – 30-50% and over.

On the basis of results from researches and work of many years' system of agro-ameliorative measures had been substantiated and developed to prevent from the processes of degradation of black soil irrigated massive in the region and to increase their fertility. At present the system of measures proposed by us is being introduced in two farms of Odessa Region as a pilot-experimental activity.

Conclusions

1. Studies of the processes of composition, properties and fertility changes in the Ukrainian South-Western Black Sea black soils have been carried out both under irrigation conditions and during current 15-20 years long post-irrigation period of their evolution. Essence and ecological & soil consequences of processes of degradation of black soil massive of irrigation in the region have been studied.

2. In the black soils studied most often revealed are the processes of decarbonization, irrigational salinization and local salting of soils, degradation of humus state, ecological & agrochemical state and agro-physical state indicators.

3. System of agro-ameliorative measures has been substantiated and is being introduced as a pilot experiment to prevent processes of degradation of the black soils of irrigated massive and to increase their fertility.

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