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GROUP, FRACTIONAL COMPOSITION, AND CHARACTERISTICS OF THE HUMUS CONTENT OF TYPICAL SEROZEMS

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Abstract:
The article describes the agrophysical properties of irrigated soils as a result of erosion processes, the state of humus, the change in biological activity, the characteristics of the agrophysical properties of irrigated gray soils of the region, the level of humus, the biological activity and processes occurring in soils under the influence of erosion, the restoration, conservation and increase in the productivity of eroded soils its scientific basis. The practical significance of the research results lies in the fact that recommendations aimed at preserving and increasing the productivity of irrigated typical serozems have been compiled cartograms on the biological activity of soils and agrophysical properties, humus status, information based on the establishment of measures for the placement of crops on soils with varying degrees of erosion and their effective use. Most of these sources are aimed at improving soil fertility, their composition, the state of humus, at conducting long-term stationary experiments using modern methods and approaches, as well as at analyzing databases created over the entire period of their implementation, based on regional agricultural technologies, the humus state of arable soils of the region, it was possible to determine the optimal parameters.

Keywords: humus, humic acids, fulvic acids, degree of erosion, southern exposure, northern exposure.

1 INTRODUCTION

Today, "11 % of the total land area of the world or 14.5 million km^2 of land suitable for production. The world's land area is 13.2 billion hectares, of which 12 % (1.6 billion hectares) is currently used for crops, 28 % (3.7 billion hectares) is under forest, and 35% (4.6 billion hectares) are meadows and forests. Countries occupy approximately 22% of the land area [1-4]. Therefore, the determination of the current state of soils in the countries of the world, their changes under the influence of natural and anthropogenic factors, the prevention of degradation and the improvement of the state of humus are considered topical issues [5-8].

The study of the history of the soil and its use shows that the most active and powerful factor in the formation of the soil profile and fertility are humic substances. The diversity of soils in nature is directly related to changes in the composition and properties of humic substances, their combination and forms of influence on the mineral mass and thickness of the soil [9, 10].

There are many sources of information about soil humus, its origin, role in soil fertility and ecological significance in the world and in Uzbekistan: N. E. Zavyalova [1], D. O. Rogozhin, [2], A. A. Romanovskaya [3], Markgraf W., Watts C.W., Wally W.R., Hrkach T., Horne R. [10], M.M. Toshkoziev [9]; N. B. Raupova [5]; and others.

Most of these sources are aimed at improving soil fertility, their composition, the state of humus, at conducting long-term stationary experiments using modern methods and approaches, as well as at analyzing databases created over the entire period of their implementation, based on regional agricultural technologies, the humus state of arable soils of the region, it was possible to determine the optimal parameters.

According to Raupova [5, 6], from the point of view of humus formation, the state of humus, the elemental composition of humic substances, the physicochemical properties and productivity of mountain and foothill soils of the Western Tien Shan, mountainous from new materials, clear scientific and practical significance. Recommended to use when describing soil diagnostic indicators [4], developing measures for the conservation, restoration and improvement of soil fertility, lecturing in the field of soil chemistry.

2 MATERIALS AND METHODS

Field and laboratory studies were carried out according to standard methods generally accepted in agricultural soil science. The study used comparative geographical and chemical-analytical methods. Analyzes were carried out according to the instructions "Agrochemical methods of soil research".

The group and fractional composition of soil humus was carried out according to the method of Plotnikova-Ponomareva modified by Tyurin [7]. The provision of soils with humus is divided into groups according to the scale of indicators M. M. Toshkoziev [5].

Variably eroded typical serozems are of scientific and practical interest from the point of view of studying the qualitative composition of humus, the direction of the soil formation process and, accordingly, the formation of humus when used in agriculture, as well as the development of measures to enrich soils with organic substances.

3 RESULTS AND DISCUSSION

As is known from the literature, to determine the degree of washout of eroded soils, in addition to morphometric studies, the humus cross section, the qualitative composition of humus, and formation characteristics are used as additional indicators. In strongly eroded soils, the SGK:SFK ratio is divided according to, they are mostly below one, 10% of them are 0.58-0.70; 30% have indicators from 0.70 to 0.84–1, a large amount of moderately eroded soils is characterized by a ratio of 1.4–2.

Weakly eroded soils are characterized by a ratio of 1 to 2.8, and non-eroded soils by a ratio of 1.2 to 3.80. The conditions of soil formation, as well as the processes of decomposition of organic residues and formation of humus, are completely different in the conditions of our soils. The soil humus formed in the hilly zones differs in its quality from the humus of the soils of other regions. The group composition of humus of typical gray soils is shown in the tables, from which it can be seen that the upper layers of leached soils on the northern slopes contain the highest organic carbon content of 1.719-1.250%, which is significantly higher than that of such layers on the southern slopes (Tables 1 and 2).

Table 1. Group and fractional composition of humus in typical eroded gray soils (northern slope).

Erodibility	Depth, cm	Carbon, %	Humic acids				Fulvic acids					Non-hydrolyzed substances %	SGK:SFK
			Associated with free and active semioxides	Calcium (Ca^{++})	Associated with stable forms of clay minerals and	Total	Associated with free and mobile oxides	Associated with 1 fraction of humic acids	Associated with 2 fractions of humic acids	Associated with 3 fraction of humic acids	Total		
Not erosion	0-20	1250	6.71	10.08	9.1	25.89	3.7	6.8	10.78	7.85	29.13	45	0.88
	20 - 47	0.720	4.30	9.01	8.65	21.96	4.0	6.5	10.45	7.35	28.3	49.74	0.77
	47 - 87	0.380	3.20	8.50	5.90	17.06	3.6	5.7	10.25	7.07	26.62	55.78	0.66
	87 - 100	0.310	2.65	7.35	4.95	14.95	3.3	4.0	9.10	6.90	23.31	61.75	0.64
	100 - 115	0.302	2.35	6.65	4.60	13.6	3.0	3.8	9.20	6.15	22.56	63.44	0.60
	115-125	0.300	2.10	6.25	4.15	12.5	2.7	3.4	8.55	5.50	20.15	67.35	0.62
	125-160	0.295	1.95	5.50	3.30	10.75	2.1	3.0	7.50	5.05	17.65	71.6	0.60
Moderately eroded	0-12	0.573	2.95	8.45	7.60	19	3.9	6.0	10.25	8.10	28.25	52.75	0.67
	12 - 27	0.498	2.75	7.95	7.10	17.8	3.7	5.2	9.90	7.60	26.4	55.8	0.67
	27 - 47	0.405	3.50	6.50	6.80	16.8	4.2	5.5	9.10	6.80	25.6	57.6	0.65
	47 - 69	0.272	3.40	4.85	5.96	14.21	4.1	5.1	8.86	6.05	24.11	61.68	0.58

	69 - 90	0.167	2.40	4.75	4.90	12.05	4.0	4.9	8.74	5.75	23.39	64.56	0.51
	90-130	0.109	2.15	4.55	4.35	11.05	3.9	4.5	8.15	5.05	21.6	67.35	0.51
	130-160	0.081	2.1	3.90	4.10	10.1	3.5	3.9	7.90	4.95	20.25	69.65	0.49
Eroded	0-27	1719	7.05	11.50	10.75	29.3	3.9	6.0	13.04	10.95	33.89	36.81	0.86
	27 - 42	1238	6.90	12.20	10.25	29.35	3.5	6.3	12.40	10.31	32.51	38.14	0.90
	42 - 68	0.493	6.10	13.35	8.15	27.6	3.7	5.2	13.80	11.21	33.91	38.49	0.81
	68 - 95	0.551	4.75	14.55	8.55	27.85	4.2	5.5	15.25	12.35	37.3	34.85	0.74
	95 - 135	0.365	4.65	13.00	9.35	27	4.5	5.6	13.32	11.20	34.62	38.38	0.77
	135-147	0.284	3.80	13.80	8.33	25.93	4.6	5.7	13.65	12.20	36.15	37.92	0.71
	147-160	0.185	3.65	12.50	8.10	24.25	4.6	5.8	14.00	13.20	37.6	38.15	0.64

At the same time, the amount of carbon in non-eroded soils is close to such indicators, and in the upper layers the indicator is 1.250-0.720%. This is the minimum amount. On moderately eroded soils, it is observed on the southern slopes.

In the moderately eroded soils of the northern slopes, the amount of organic carbon is slightly higher in the upper layers of 0.573-0.438% and gradually decreases to 0.109-0.081% towards the bottom of the soil sample. 0.551-0.237% in the upper layers of the southern slope, and sharply decreases to 0.81% towards the bottom.

In the group composition of humic substances of the studied soils, fulvic acids are significantly superior in humic acids. In soils accumulated by erosion, the SGK:SFK ratio approaches 1 in the upper layer on both sides of the slope, and the SGK:SFK ratio is 0.8-0.88. It gradually decreases to 0.74-0.62.

Approximate values of the ratio of humic acid carbon to fulvic acid carbon (SGK:SFK), obtained from arable layers of non-eroded soils, on the northern and southern slopes, this ratio is limited to 0.67-0.72. The upper layers of the studied soils, collected as a result of erosion and not subjected to erosion, are fulvate-humic by the type of humus, downwards this ratio decreases to 0.58-0.54 and 0.74-0.64, which is associated with a decrease in the group of humic acids. Moderately eroded soils vary greatly in SGK:SFK ratio as well as in humus type. In the arable layers, this ratio is 0.67 on the northern slope, 0.72 on the southern slope and belongs to the humus-fulvotine type of humus. The fulvate type of humus on the northern and southern slopes is characterized by sooty layers of moderately non-eroded soils, in which the SGK:SFK ratio is limited to 0.49-0.38. The greatest hydrolysis of humic substances for the northern and southern slopes is characteristic of soddy soil layers accumulated as a result of erosion. Here SGM:SGUM is 1.94-1.68%. Downward hydrolysis decreases by 1.46-1.09%, which is associated with a decrease in the contribution of humic acids. Both types of slopes of non-eroded and moderately eroded soils are characterized by weak hydrolysis, in the upper layers the SGM:SGUM ratio is 1.29-1.33%, in non-eroded soils, in medium eroded soils 0.92-0.89%.

The amount of humic acids in the investigated soils is much higher in the soils that have not been eroded and accumulated as a result of erosion: 45-71.6% in the northern exposure, 42.9-52.8% in the southern exposure in the upper layers. The amount of hydrolyzable substances in the lower layers is less than 60% up to 36.81-52.75% in the soils of the northern slope, 37.2-52.8% in the southern slope.

According to the ratio of humin and fulvic acids separation, it is not possible to work out the conditions of its change, the fact that the soil cross-section has been subjected to erosion processes can be seen in the distribution of soil total and humic acid carbons. Soils that have not been eroded and accumulated as a result of erosion are characterized. 25.4-28.6%, 25.89-29.35% ratio in upper layers, 10.4-20.4%; 14.95-25.93% in the lower layers and vice versa with the least amount of moderately eroded rocks, 14.21-19.00% in the upper layers, and 4.0-10.40% in the lower layers.

According to the results of the analysis of the fractional composition of humus in eroded soils, there are some differences in the accumulation of humic substances depending on the exposure of the slope and the degree of erosion. But at the same time, a common feature for them is the predominance of fraction 3, associated with clay minerals, oxides of one and a half degrees, and fraction 2, associated with a large amount of calcium.

The soils of the southern exposure differ from the northern exposure in the amount of the humic acid fraction. Humic acids in the upper layers of soils of southern exposure, not subjected to erosion and accumulated as a result of erosion 3rd faction dominates. (11.4 and 10.6% of total soil carbon), and in moderately eroded soils, when this fraction dominates, its amount is significantly reduced (from 7.3 to 4.4%). The next place is occupied by 2 fractions of humic acids. Its amount in the upper layers is 7.3% (Tables 1 and 2). The largest number of fractions 2 and 3 of humic acids is in the upper layers of soils accumulated as a result of erosion, and is 10.1 and 10.6%. In the unwashed and eroded soils of the northern exposure, fraction 2 of humic acids predominates compared to the southern exposure. This fraction depends on Ca ++ (about 11 and 15% of total soil carbon), and in moderately eroded soils, the value of this fraction decreases slightly, followed by 3 fractions of humic acids, the amount of which is limited to 6.8-12.5% in the upper layers.

Table 2. Group and fractional composition of typical humus in eroded gray soils (southern slope).

Erodibility	Depth, cm	Carbon, %	Humic acids				Fulvic acids					Non-hydrolyzed substances %	SGK:SFK
			Associated with free and mobile oxides	Calcium (Ca ++)	Associated with clay minerals and stable forms	Quantity	Associated with free and re-active oxides	Associated with 1 fraction of humic acids	Associated with 2 fractions of humic acids	Associated with 3 fraction of humic acids	Quantity		
Not erosion	0-5	0.707	5.0	9.0	11.4	25.4	3.2	7.3	10.6	10.6	31.7	42.9	0.80
	5-15	0.609	3.8	7.6	7.9	19.3	3.9	7.6	9.5	9.9	30.9	49.8	0.62
	15-30	0.226	2.3	3.2	5.1	10.6	2.3	4.3	6.4	7.7	20.7	68.7	0.51
	30-50	0.162	2.1	3.5	4.8	10.4	2.0	3.9	7.2	6.2	19.3	70.3	0.53
	50-70	0.116	2.0	2.5	3.0	7.5	2.0	2.5	5.6	3.7	13.8	78.7	0.54
Moderately eroded	0-5	0.551	4.2	3.4	7.3	14.9	4.2	6.3	7.3	9.5	27.3	52.8	0.72
	5-15	0.237	2.0	3.4	4.4	9.8	3.0	2.9	3.8	5.3	15.0	75.2	0.65
	15-30	0.145	1.2	2.0	2.8	6.0	2.2	2.4	2.8	3.6	11.0	84.0	0.54
	30-50	0.081	0.7	1.4	2.1	4.2	2.5	2.1	1.4	4.3	10.3	86.0	0.40
	50-70	0.081	0.7	1.4	1.9	4.0	2.8	1.4	1.4	2.8	10.4	85.6	0.38
Eroded	0-5	1.038	7.9	10.1	10.6	28.6	4.0	7.9	10.6	11.7	34.2	37.2	0.84
	5-15	0.800	5.8	10.1	11.6	27.5	4.0	7.9	10.9	13.7	36.3	36.0	0.73
	15-30	0.644	4.5	8.1	10.8	23.4	4.5	6.3	9.9	14.4	35.1	41.5	0.66
	30-50	0.383	4.5	7.5	10.6	22.6	4.5	6.1	10.6	13.4	34.8	42.6	0.65
	50-70	0.226	4.1	6.1	10	20.4	3.8	5.1	10.2	12.8	31.9	47.7	0.64

The largest number of fractions 2 and 3 was determined in the upper layers of the studied soils with different degrees of erosion. Their largest number is in soils that have not been eroded (11.3-8.5%) and accumulated as a result of erosion (12.9-11.2%), and the smallest - in moderately eroded soils (8.7-6.5%). It should be noted that the 2nd and 3rd fractions of humic acids are significantly reduced in all the observed soils. Due to the carbonization of these soils, fraction 2 of humic acids prevails over fractions 1 and 2. In the soils studied by us, the Ca^{++} dependent fraction of humic acids predominates, depending on the amount of Ca^{++} in the soil.

3 fractions of humic acids in typical gray soils, fulvic acids of soils of northern and southern exposures are mainly represented in 2 and 3 fractions. It is also possible to identify a significant amount (3.7-3.9%) of fulvic acids of the 1a-fraction associated with free and reactive oxides of the sesquilevel. Indicators of fractions related to Ca^{++}. The mass of these fractions reaches 10.78-13.04% in all soils of northern exposure. All soils contain more fulvic acids and humic acids in the humus composition.

Thus, it can be said that in the studied soils, the simpler, unstable, and more dispersed humic form of fulvic acids prevails over the more complex, stable high-molecular form of humic acid humus.
Therefore, it was noted that the proportion of humic acids in the composition of mobile humic substances in non-eroded soils is high. In our opinion, the higher the amount of humic acids in the labile form of humus in the soil, the higher the soil's ability to resist erosion, and the greater the total amount of this group has a positive effect on soil fertility.
Knowledge of the complex and generalized characteristics of soils belonging to different types and groups is important in solving the genetic problems of soil science and a number of practical issues. Knowing the general description of hummus, it is advisable to highlight its most important indicators and study them in groups. Among the organic substances that make up the humus, humic acids and their organo-mineral derivatives are of the greatest importance.
The state of soil humus is characterized by a set of indicators that is, the level of humus accumulation, its distribution over layers, qualitative composition, and the migration ability of organo-mineral derivatives and humic substances. It should be said that excellent studies were carried out to check the amount of humus in the soil of our republic, changes in its quantity and quality during long-term use in irrigated agriculture, but according to their results, final information was not provided on the humus status of the available soils by their types, types and differences.
The humic condition of the soils according to the modification of M. Tashkuziev [6] the humic condition of the typical gray soils subjected to erosion according to the modification of M. Tashkuziev [6] the amount of humus in the A-layer of the irrigated typical gray soils according to the classification scale is 1.22% above the average when it is not eroded in the northern exposure, the average eroded is 0.95% less, accumulated as a result of erosion accumulated 1.79% - higher than average, 2.15% higher when not eroded in southern exposure, 0.98% less than average eroded, 2.96% higher accumulated as a result of erosion.
When studying the percentage of humus in the A-layer of typical gray soils irrigated with northern exposure and southern exposure, it is clear that their content is significantly reduced in the southern exposure. Humus reserve per t/ha (0-30; 0-100 cm) humus status of typical gray soils with erosion in the northern and southern exposures irrigated in the 0-30 layers of typical gray soils without erosion is 27.16%- low, 16.72% - very low, average eroded 19.40-9.26%- very little, accumulated as a result of erosion 42.57%- average, 29.48% low. In the 0-100 cm layer, when the northern exposure is not eroded, 90.55%-high, moderately eroded 64.68%-higher than average, 141.0% accumulated due to erosion is very high.
The supply of humus with nitrogen according to the modification of D.S. Orlov [5], M. Tashkuziev [6] in typical gray soils of northern exposure and southern exposure irrigated without erosion is 11.6% - low, 7.44% - high, moderately eroded 7, 10-6.26%-high, 13.2%-low, accumulated as a result of erosion, 8.9%-average.
The degree of humification of organic matter in the northern exposure is 20.56%-moderate, in the average eroded 39.69%-high, in the accumulation due to erosion 17.75%-weak, in the southern exposure 35.92%-high in the non-eroded, in the average eroded 27, 04%-medium, 27.55% is the average amount in soils accumulated as a result of erosion.
The percentage of "free humic" acids in the sum of GK and in the typical gray soils of the southern exposure irrigated is 22.8% lower when not eroded in the northern exposure, 15.3% very low when moderately eroded, 20.5% lower accumulated as a result of erosion; 19.6% was found to be very low when not eroded in the southern exposure, 28.1% low when moderately eroded, and 27.6% low accumulated as a result of erosion.
Proportion of Ca^{++}-enriched GK, average of 44.0-35.4% non-eroded, moderately eroded 44.6% average, 22.8% higher than the sum of GK in typical gray soils irrigated by northern exposure and southern exposure 42.4-35.3% average.
The percentage of GK firmly bound to the mineral part of the soil, from the sum of GK in typical gray soils of northern exposure and southern exposure irrigated without erosion, 33.1-44.8%, moderately eroded 40.0-48.9%, accumulated as a result of erosion 36.9- 3.0% is the average.
Humus type SGK:SFK in typical gray soils of northern exposure and southern exposure irrigated without erosion 0.83-0.80%, moderately eroded 0.67-0.72%, accumulated as a result of erosion 0.85-0.84% humic-fulvate constitutes.
According to the optical density of humic acids [9], it is 0.06% lower when it is not eroded and accumulates as a result of erosion in typical serozems of northern exposure and southern exposure of irrigated; the average erosion rate of 0.04 % was very low.
Therefore, the humus group and fractional composition index differ by the size of the soil that has not been eroded and accumulated as a result of erosion. Humus content and quality are lower in moderately eroded soils. Erosion processes have a negative effect not only on the humus content and humus stock, but also on the humus fraction.
According to the indicators of the humus state of soils, the northern exposure and the southern exposure have higher indicators of the group and fractional composition of humus than the soils of the southern exposure. This is due to the fact that the northern exposure is characterized by improved soil moisture, climatic conditions and vegetation cover. The yanabial exposure is determined by the low humus content and fractionation of the soil, which is characterized by a dry climate and poor vegetation cover.

4 CONCLUSIONS

When using irrigated gray soils in the process of irrigation, the processes of dehumification and mineralization in the soil are accelerated, as a result, the amount and supply of humus decreases, and the SGK:SFK ratio decreases. In typical gray soils, the SGK:SFK ratio before the experiment was 0.55-0.81, and the SGK:SFK ratio was 0.50-0.77 after the experiment.

Fertilizer 20 t/ha in the fractional composition of soil humus includes fraction 2 associated with Ca^{++} (8.9-9.1) and fraction 3 associated with stable forms of clay minerals and semioxides (11.6-13.2), increased to According to field experiments, it was found that in the fractional composition of soil humus in the control variant, humic acids of fraction 1 decreased, in the composition of humic acids of fraction 2, the share of Ca^{++} bound fraction was higher.

Southern exposure soils differ from northern ones in the amount of humic acids fraction. The 3rd fraction of humic acids dominates in the upper layers of washed-out and non-eroded soils of the southern exposure.

Among the fractions of fulvic acids, the values of the fractions related to Ca^{++} are high. In the soils of northern exposure, the weight of fractions related to Ca^{++} reaches 11.5-14.04%. All soils contain more fulvic acids and humic acids in humus.

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