STRUCTURAL-AGGREGATE COMPOSITION AND WATER RESISTANCE STRUCTURE OF AGROCHERNOZEMS IN THE ZONE OF INFLUENCE OF THE MINING ENTERPRISES (ON THE EXAMPLE OF GUBKINSKY DISTRICT OF THE BELGOROD REGION)

MEZENTSEVA M.S., NOVYKH L.L.
Belgorod State National Research University, Russia

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Abstract
A comparative study of virgin soil and agrochernozem in a zone of influence of the mining enterprise was examined. Despite the degradation of the soil structure and its water stability, caused by prolonged due to ploughing up, the quality of the structure of agrochernozems is assessed as good.

Keywords: KMA, agrochernozems, rocks, dust, valuable units for agronomy, waterproof structure

Introduction
The Belgorod region is unique in its mineral resources of the region of Russia. Here are revealed and in varying degrees, also has large deposits of iron ore, bauxite, apatite, underground mineral waters, building materials. Industrial potential of the region is largely determined by the extraction and processing of iron ore. On the State balance sheet for the Belgorod region in the 01.01.2012 were listed 14 of iron ore deposits with reserves was 51.0 billion tons. Production of iron ore mining enterprises of the region in 2012 was 88.6 million tons [1]. In the area was made 37.3 million tons of iron ore concentrate and 12.5 million tones of pellets [2]. Such a powerful development of the mining complex leads to increasing the area of technogenic landscapes and the deterioration of the environment [3].

With the purpose of definition of the control of pollution and the degradation of soils to establish measures for their protection, improvement of soil fertility and sustainable use in the framework of the engineering-ecological investigations, according to GOST 17.4.2.03-86 [4], the soil studies are being conducted with drawing up of the passport of the soil. At the same time the soil, before getting into the zone of influence of the mining enterprises, for a long time were in agricultural use, which could not but tell on their properties.

An important property of the soil, significantly determinant of crop plants, is its structural-aggregate composition. The structure has an impact on plants through the formation of water, air, nutritious, heat regimes, i.e., functionally. The main indicators of the condition of the structure are the contents of the valuable units for agronomy s of the size of 10-0.25 mm and its resistance to external influences, among which the most significant is the impact of water [5].

Detailed studies of the structure of soils and its transformation under the influence of agricultural use were held by V.V. Medvedev [6]. It is proved that increasing of lumpy of the pasture soils and deterioration in connection with this, the quality of the structure are taken place. Characterizing the agrochernozems in modern classification of soils of the Russian Federation [7] one can indicate that dispersed soil weight of such soils is consolidated into solid blocks,

which are crushed in the process of processing of soil separately, unstable to wetting and are practically devoided of the intra aggregate pores.

The aim of our research was to determine the degree of degradation of the structure of the agrochernozems, which are the background soils in a zone of influence of the mining enterprises on the territory of the Gubkinsky district, and also to receive the information about the state of soils for their involvement in an industrial zone for further monitoring.

Materials and methods. Field survey of soil cover of the study area was held in July 2012. The feature of the location of the Lebedinsco-Soylenskaya group of KMA led to the fact that the mining enterprises are located in the immediate vicinity of the nature reserve area «Yamskaya steppe», which allows to compare the structure of the agrochernozems and options of virgin soil.

On the virgin lots were selected soil samples in the existing soil profile. On the arable area was laid soil cut depth 140 cm. Both cut were on the plax areas.

Determination of soil based on the substantive-genetic classification of 2004 [7] proved that on the virgin lot is presented migration-micellar medium capacity deep carbonate from medium - to heavy loamy chernozem; at the plow was described migration-micellar medium capacity highly carbonate and medium loamy agrochernozem. Soil samples were taken up to a depth of 40 cm in 10 cm, and below - after 20 cm to a depth of 140 cm. Thus, from each transect was selected from 9 samples.

For the diagnosis of the structural-aggregate composition of soils was used sieve method by N.I. Savvinov [8]. According to the results of the «dry» screening was calculated coefficient of the structure of the soil; on the results of the «dry» and «wet» screening - coefficient of water resistance [6]. Assessment of the structure and its water stability was carried out in [5]. For the calculation of correlation dependences, we used data on the content of humus in the soils, received by A.V. Tkachenko and I.E. Novykh. Determination of the fair exceeded by method of pair wise comparison was carried out in [9].

Results and their discussion. Figure 1 shows the profile of the distribution of blocs and dust in the studied soils. Limits for soil make 0.2-51%; for agrochernozem - 21.4 - 51.6 %. Average values of the blocks for the study of the profiles are equal to 18.8 % of (virgin) and 34.4 % (arable land). The variation is estimated as very high for the ground, and the average for agrochernozem is estimated as medium (table. 1).

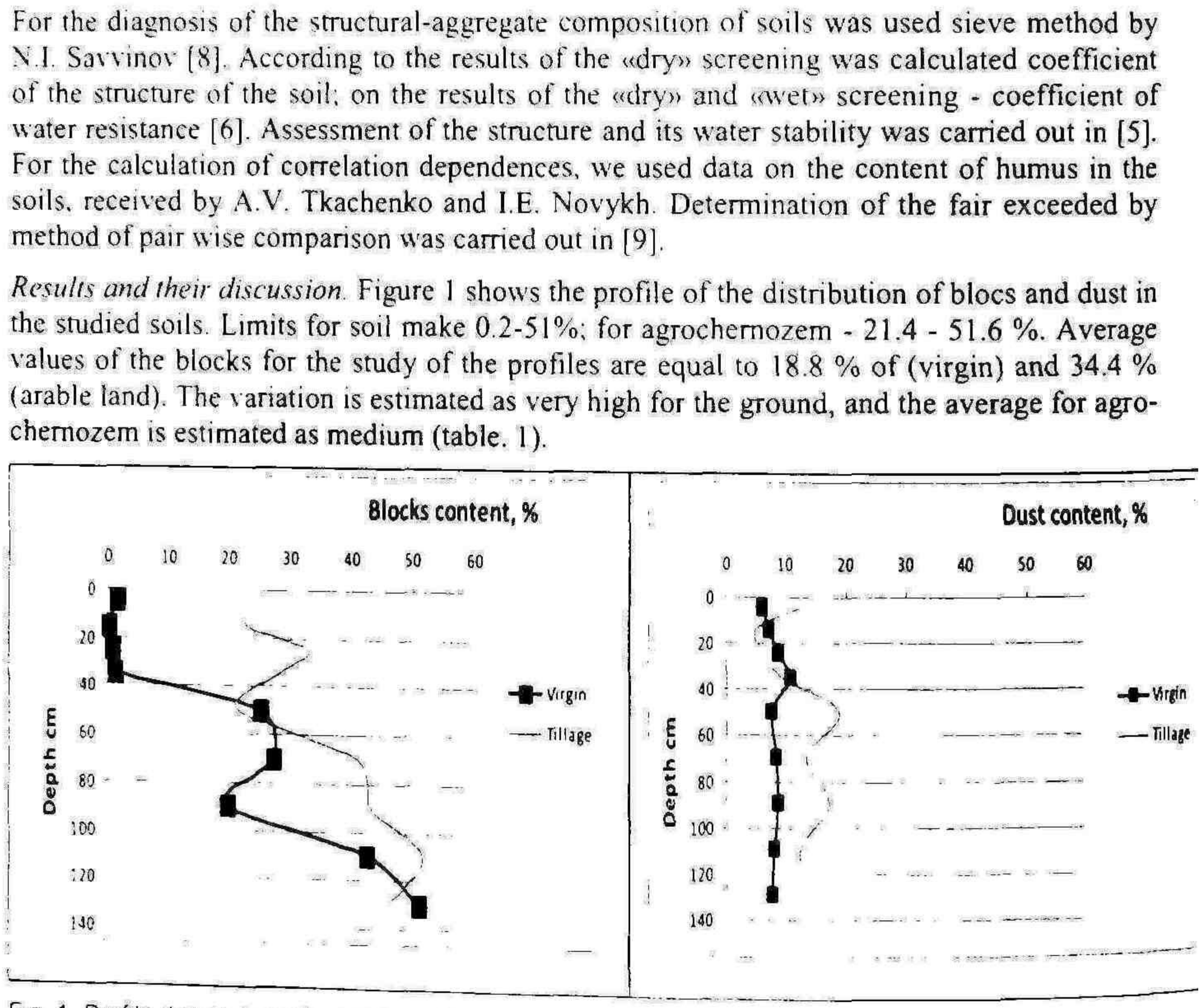

Fig. 1 Profile distribution of agronomically not valuable fractions - blocs (> 10 mm), and dust (< 0.25 mm).

Table 1: Statistical parameters of the analyzed samples

Index	*X mid.*		*V*, %	
	virgin	tillage	virgin	tillage
1. Blocks content, %	18,8	34,4	103	33
2. Dust content,, %	8,3	12,3	16	38
3. Content of AVF. %	72,9	53,5	26	25
4. K mid.	5,39	1,32	87	53
5. Total water re-sistance, %	64,0	50,2	24	26
6. Кв	0,70	0,55	24	27

The increased content of blocks in the layer is 20-30 cm in agrochernozem may be caused by the formation of a «Sole Shoe». The appearance of the maximum of the soil at a depth of 60 cm testifies about the manifestations of illuvial process. In both profiles maximum content blocks is typical for the breed.

In table 2 the results of estimating the fair exceeded. With a probability of 95% can be argued that in the profile agrochernozem content blocks, on average, is significantly higher than in the profile of the virgin chernozem, more than in 6 times. Found a strong negative correlation between the content of humus and lumpyness of soil: r = - 0,78.

Table 2: Assessment of the fair exceeded the method of pair comparisons

Index	*(X1:X2) mid.*	The excess of the fair *M*
1. The content of blocks to a depth of 120 cm– «tillage : virgin»	38,9	6,3
2. The content of dust - «tillage : virgin»:		
0-140 cm	1,50	1,01
40-140 cm	1,86	1,40
3. The content of AVF 0-140 cm «virgin : tillage»	1,37	1,20
4. Kc 0-140 cm «virgin : tillage»	3,48	1,96
5. Total water resistance 0-140 cm «virgin : tillage»	1,31	1,12
6. Кв 0-140 cm «virgin : tillage»	1,30	1,09

Analysis of the profile of the distribution of dust (see Fig. 1) shows that the limits of its content in the black soil are the 6.2-10.9 % and in agrochernozem - 4,9-19,1 %. Average values of the content of dust in the profiles of soils are equal to 8.3% (virgin) and 12.3 % (tillage). The variation of the virgin area a little, but on the tillage - middle (see table. 1).

About the presence of spraying process structure in the arable horizon shows increase of the content of dust in deeper horizons. Indeed, dispersed soil mass agrochernozem in the upper layers of consolidation in solid blocks, and below there is the process of moving dust in the profile of the soil. The calculations have shown, that in all the soil profile of the fair the excess of dust in the agrochernozem compared with chernozem is only the 1.01, however, if we consider the layer from 40 to 140 cm, then it increases and 1.40. Reliable connection between the content of dust and content of humus is not detected.

Limits on content of the agronomically valuable fractions (AVF) in the black soil are 41-92 %; in agrochernozem - 36-72 %. The average content of AVF in the profiles of soils as well 72.9 % (virgin) and 53.5 % (arable land); the variation of the average (see table. 1), significant exceeding of the indicator in the black soil, compared with agrochernozem, by 1.2 times (see table. 2). Figure 2 shows the profile distribution of agronomically valuable fractions. Draws attention to the fact that the virgin area around the profile of the content of these factions above, than on the arable version. Established a strong positive relationship between the content of humus and AVF: r = 0.79, i.e. 62 % of the variation of the content of AVF due to the wide variation in the content of humus.

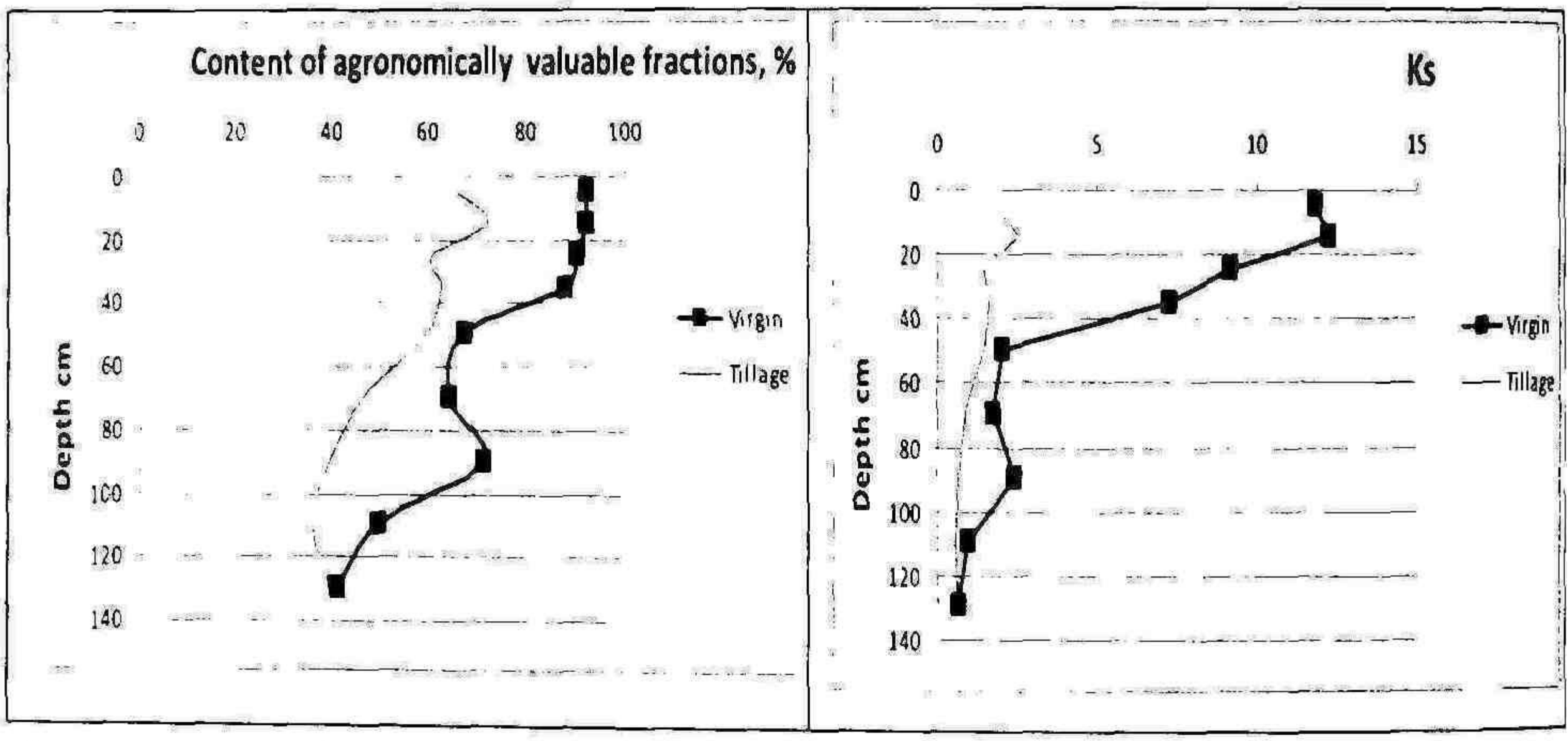

Fig. 2. Profile distribution of the agronomically valuable fractions (AVF) and the coefficient of structure.

Clearly manifest differences in structural and aggregate composition of the soil in the analysis of the coefficients of structure. Limits of the indicator for the chernozem are 0.7-12.2; for agrochernozem 0,6-2,6. Average values in the profiles of soils make 5.39 (virgin) and of 1.32 (tillage). The variation is estimated as very high for virgin area and high arable (see table 1). In the profile of the virgin soil of the COP reliably almost two times higher than in agrochernozem.

By the values of the Kc, you can assess the quality of the soil structure: in chernozem it is excellent to a depth of 100 cm, lower - good; in agrochernozem - excellent up to a depth of 40cm, then up to 80 cm good, and below - poor. Shown a strong positive relationship between the humus content and the Kc : r = 0.76, i.e. 58 % of the variation of the Kc is connected with the variation of humus content.

Figure 3 presents the profile distribution of total water stability. Limits it to the black earth are 34-84 %, in agrochernozem - 27-63 %. Average values of the content of water-stable microfractions of the size of more than 0.25 mm in the studied soils are equal to 64 % (virgin) and 50 % (arable land) (see table. 1). The variation of the indicator is assessed as average.

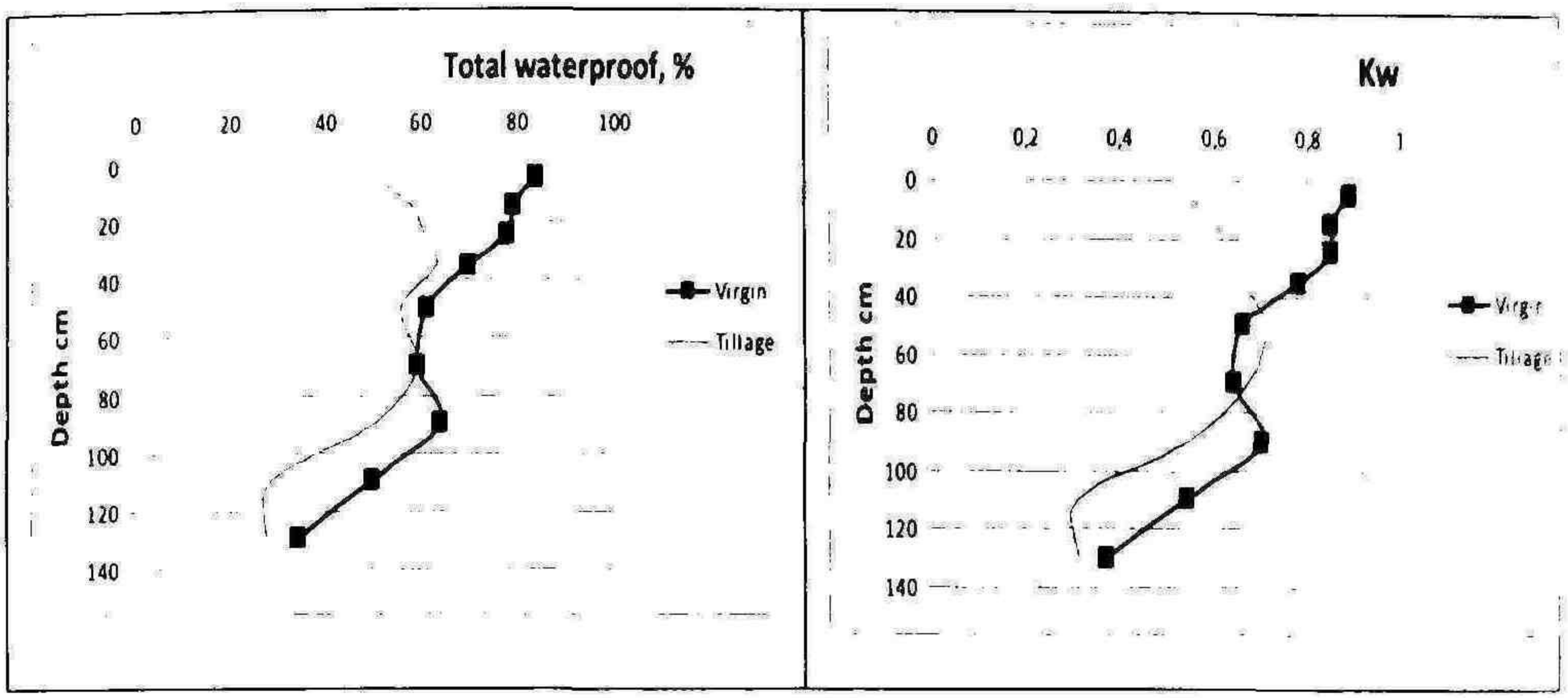

Fig. 3: Profile distribution of total water stability and the coefficient of waterproof structure

With a probability of 95 % can be argued that in the profile of the soil total water resistance the structure of present fairly in 1.12 times higher than in agrochernozem. In this respect, the assessment is being made of waterproof structure. For the black-soil lands in the layer of 0-30 cm, she is excessively high, from 30 to 130 cm - good, below is satisfactory. In agrochernozem waterproof structure is good from 0 to 100 cm, lower - unsatisfactory. Found strong positive relationship between the content of humus and total water resistance: r = 0.77, i.e. 59% of the variation of the total water stability is connected with the variation of humus content.

Curves of the profile of the distribution of the coefficient of waterproof structure are very similar to the curves of the total water stability. Limits of the indicator for the chernozem – 0.37-0.89, for agrochernozem is 0.31-0.71. Average values are: 0.70 (virgin) and 0.55 (arable land). The variation is average (see table. 1). Calculations of fair excess showed that the virgin division Kv in 1.09 times significantly higher than in the arable. Found a close relationship between the content of humus and Kv : r = 0,72, i.e. 52 % of the variation Kv was caused by varying the content of humus.

Conclusion. Thus, the obtained data confirm the presence of the degradation of the structures in continuous cultivation: growing lumpyness and dustness, reduced the content of the agronomically valuable fractions, ratio of structure, total water resistance structure and its coefficient of water resistance. At the same time, the «margin of safety» of the structure of chernozem so great that even when reliable decrease of the coefficient of the structure is almost two times the quality of the structures in agrochernozem corresponds to the excellent and good, and water resistance is characterized as good.

All analyzed indicators, with the exception of the content of rocks and dust, are strongly positively correlated with the content of humus. The contents of blocks are also closely correlated with the humus content, but by the type of a negative relationship.

Thus, the transformation of black earths in agrochernozems, in spite of their structural properties, has not led to a significant deterioration of the characteristics of the fertile soil layer; it is still valuable for remediation.

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