MODERN TRENDS IN THE DEVELOPMENT OF AGRICULTURAL PRODUCTION

PROBLEMS AND PERSPECTIVES

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The monograph presented for review is a collection of the results of actual achievements of domestic agricultural scientists, obtained directly in real conditions. The authors are recognized experts in their fields, as well as young scientists and postgraduate students of Ukraine. Research is conceptually grouped into 5 sections: modern technologies in crop production and fodder production; economy of the agro-industrial complex; breeding and breeding in the 21th century; protection and quarantine of plants; agrochemistry and soil science. The monograph will be interesting for experts in plant breeding, economics, plant protection, selection, agrochemistry, soil science, scientific workers, teachers, graduate students and students of agricultural specialties of higher education institutions, and for all those who are interested in increasing the quantity and quality of agricultural products.

Keywords: modern technologies, crop production, fodder production, plant protection, quarantine, agrochemistry, soil science, economy of agro-industrial complex.

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THE INFLUENCE OF CONTENT ESP ON ANTI–DEFLATION STABILITY OF THE SOILS STEPPE IN UKRAINE

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In the steppe zone of Ukraine deflation (wind erosion) of soils is a fairly ordinary phenomenon. An important factor of deflation is the ability of soils in the region to confront blowing out in the most wind erosion seasons (February–April). This factor is entitled "anti–deflation stability of soils. The relevance of our research is caused by increase of winter air temperatures and unsustainable management of land owners. The aim of our study is to establish the influence of content of elemental soil particles and climate on transformation of anti–deflation stability of soils in Steppe zone of Ukraine. Anti–deflation stability of black soils, chestnut and sandy loam soils in Steppe zone of Ukraine was investigated on the system of key areas, which are incorporated in Kherson and Mykolayiv regions. As a result of the study, it was found that when the content of elemental soil particles (up to 10–12 %) is the highest, the index of anti–deflation stability of chernozems and dark chestnut soils is the highest (r – 0.65), and when the content of ESP exceeds this limit, then the anti–deflation resistance of these the soil begins to decrease substantially. With employ a regression method we nominate three groups of soils for wind–resistant. On the first group, most wind–resistant been a load and average clay soils (VS > 50 %) with content organic matter 2,5–4,0 %, to the second wind–resistant: light clay and sandy soils (VS 20–50 %) with content organic matter 1,0–2,5 %, to the third no wind–resistant coming a sandy soils (VS 0,7–20 %) with content organic matter 0,5–1,5 %.

Key words: *elementary soil particles, structure, soil, anti–deflation stability.*

Among all soil and climate zones, deflation processes are most often manifested in the Steppe zone of Ukraine. The resistance of the soil to the action of the wind is determined by the state of its surface: the lumpiness of the soil 0–5 cm, the degree of roughness, the presence or absence of plants and plant remains, the content of fragments of rocks and minerals – elementary soil particles (ESP, %), etc. Lumpiness (aggregate composition) is expressed by the presence of soil lumps larger than 1 mm in the upper 0–5 cm soil layer. It was established that the threshold of anti–deflation resistance is within 50% structure. The state of study of the problem. The most widespread and generally available method of assessing the wind resistance of soils consists in studying the lumpiness of the upper 0–5 cm soil layer. Considering the sorting role of the wind, foreign and domestic scientists noted the facts of the transfer of soil fractions of a certain size by the wind. It is quite possible that the more deflation fractions in the soil (that is, those that are easily carried by the wind of a certain speed), the faster it is blown out. This was experimentally proven by Chepil. He showed that the degree of deflation of soils depends on the content of fractions in them, obtained during dry sieving, with a size of < 0.42 mm. The more of this fraction in the soil, the greater the losses from blowing. That is, the size of deflation fractions will be different for different soils. In the conditions of the south of Ukraine, fractions < 0.5 mm, and mainly < 0.25 mm and fragments of rocks and minerals – elementary soil particles (ESP, %) are the most easily transported (Zaitseva, 1970; Dolgilevich, 1978; Voronin, 1986; Hagen, Skidmore & Saleh, 1992; Buligin & Lisiecki, 1996; Bulygin, Timchenko, Didenko & Zuza, 2002; Khotinenko, 2007; National Agronomy Manual, 2002; Melashych, Chorny & Pismenniy, 2007; Chorny, Khotinenko & Pismenniy, 2008; Zonal guidelines to protect soil from erosion, 2010).

The main goal of the work is to study the influence of the content of elementary soil particles on the anti–deflation properties of such soils: sandy, sod–sandy, dark chestnut, ordinary chernozems and southern heavy loams in the conditions of the Steppe of Ukraine. To achieve the goal, the following task was solved: assessment of the current state of anti–deflation resistance of the above–mentioned soils in terms of their ability to counteract deflation.

Methodology and place of research

In order to study the wind resistance of the soils of the steppe zone, several dozen experimental plots were laid in plakor conditions and in slope catenal complexes in the Mykolaiv region with heavy loamy and clayey chernozems, ordinary and southern and dark chestnut soils. Soil samples were taken from the upper (0–3 cm) layer of non–eroded and eroded deposits. The wind resistance of the sandy substrates of the Lower Dnieper sands of the Kherson region and sandy dark chestnut soils, which are territorially adjacent to these sands, was also studied.

The wind resistance index, as well as the macrostructural and microaggregate composition, on which, as is known, the wind resistance index also depends to some extent, change in different seasons and depend on soil cultivation. In an attempt to exclude this influence, sampling was carried out in the spring (March–April) during the most deflationary period of the year. Agricultural use and tillage of the soil at the time of sampling were also approximately the same – cultivated pairs, winter crops or crops of winter crops in the phase of 2–4 leaves. Thus, quantitative differences in the structural and microaggregate composition of soils, wind resistance index can be associated with specific chemical and physico–chemical properties of these soils.

The study of agrochemical parameters was carried out in triplicate. Determination of soil condition indicators according to standard and standardized methods according to IS0; DSTU 2002–2007, namely: granulometric composition of soil by the pipette method in the modification of O.N. Sokolovsky; aggregate soil analysis according to N.I. Savvinov Determination of ESP and microaggregation was carried out according to original methods. As a result, the coefficient of aggregation was calculated, %. Wind resistance (anti–deflation resistance) of the soil was determined in a laboratory aerodynamic installation of our own design (Buligin & Lisiecki, 1996; Melashych, Chorny & Pismenniy, 2007).

Research results and their discussion

Direct determinations of anti–deflation resistance of soils showed (table.) that the largest indicator 65.2 % of ordinary light–clay (perelig) chernozems have anti-deflation resistance.

The next large group of soils with approximately the same values indicators of anti–deflation resistance (arable land): dark chestnut light loam – 62.8 %, southern light clay chernozems – 61.5%, ordinary light clay chernozems – 59.9 %, dark chestnut sandy loam – 58.5 %, dark chestnut heavy loam – 47.4 % and southern heavy loamy chernozems with an index of anti–deflation resistance in the range of 25.1–44.8 %. The lowest anti–deflation resistance is loose and cohesive sand (loam), in which this indicator is from 0 to 4 %, and turf–sandy soils (arable land) with an indicator of anti–deflation resistance – 19.5 %.

Table 1

The main anti-deflation characteristics of the soils of the Steppe of Ukraine

N	Coordinates		Soils	VS %	Contents aggregates %		Content of particles < 0,01, %	Humus content , %
	Latitude m (N)	Longitud e (E)			> 1 mm	< 0,25 mm		
Ordinary chornozem (light clay)								
1.	47°51,0	31°34,4	arabl	54,7	68,	8,9	60,2	3,7
7.	47°53,4	31°33,2	перелі	65,2	83,	3,4	70,7	4,2
Southern chornozem (light clay)								
10.	46°50,7	32°13,1	arabl	61,5	80,	3,1	61,2	2,6
Southern chornozem (heavy loamy)								
12.	46°56,5	31°40,6	arabl	44,8	76,	3,5	58,7	2,7
14.	46°56,4	31°40,3	arabl	40,5	57,	8,9	56,7	2,4
Dark chestnut (heavy loamy)								
19.	46°53,9	31°40,3	arabl	47,4	69,	6,3	53,3	2,6
Dark chestnut (sandy)								
25.	46°41,1	31°52,4	arabl	58,4	76,	7,0	17,3	1,0
Dark chestnut (light loamy)								
24.	46°	33°06,1	arabl	62,8	80,	6,2	23,9	1,5
Dark chestnut (medium loamy)								
20.	46°	31°50,4	arabl	41,5	54,	19,	43,8	2,4
Sod– sandy								
26.	46°31,4	32°56,9	arabl	19,5	54,	12,	9,2	0,9
Sod– sandy								
27.	46°31,5	32°57,2	virgin	4,2	32,	20,	6,8	0,5
Sandy								
28.	46°31,6	32°58,0	virgin	0,0	1,4	65,	1,4	0,4

Also, as a result of the study, it was established that, with the content of elementary soil particles up to 10–12 %, the indicator of anti–deflation resistance of chernozems and dark–chestnut soils is the highest, and when the content of elementary soil particles exceeds this limit, the indicator of anti–deflation resistance of these and other soils begins to significantly decrease (fig. 1).

That is, there is a close relationship between the content of elementary soil particles in the soil and the indicator of anti–deflation resistance of the soil. This is evidenced by the coefficient of determination, which is r – 0.65. So, it can be said that ESP take a rather close part in the formation of soil aggregates.

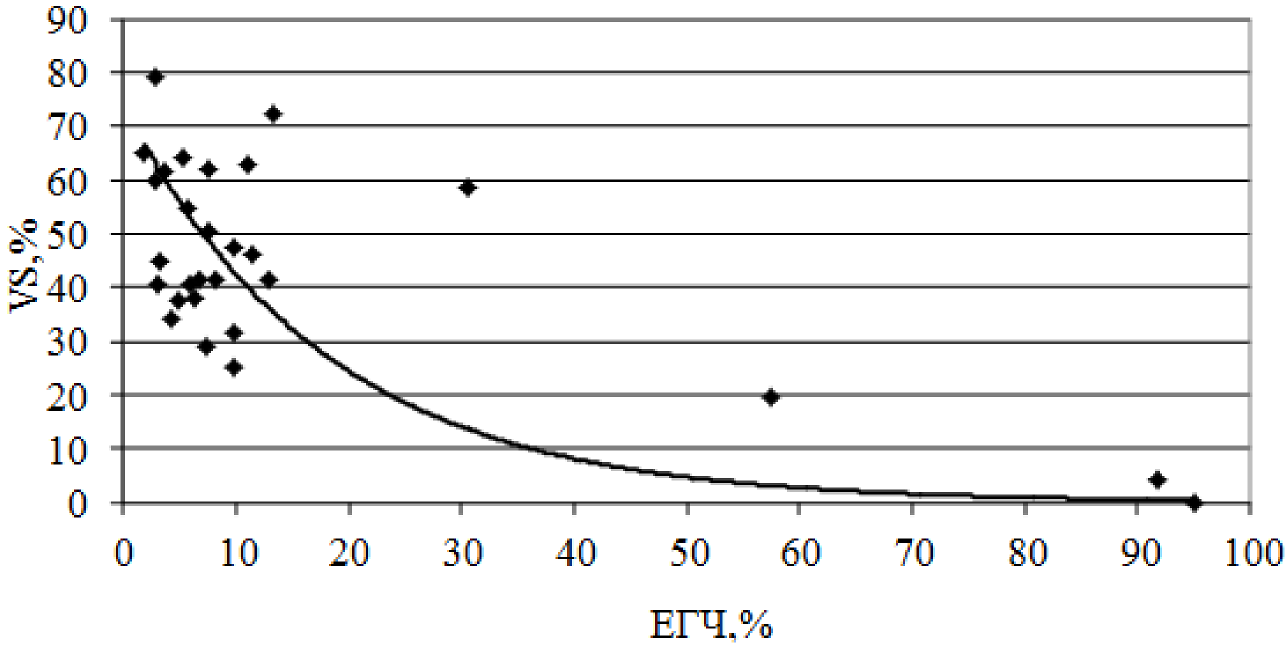

Figure 1. Dependence of wind resistance VS (%) on content ESP (%)

On the basis of the discovered field, the fallow graph and the vicorist method of regression analysis were used to estimate the equal fallow between E**SP** in % and instead in soils of physical clay and humus in %.

The equation looks like this:

$$ЕГЧ = e^{(4{,}57-0{,}48 \cdot \ln FG - 0{,}8 \cdot \ln G)} \quad (1),$$

where: FG – content of physical clay in the soil;

G – humus content in the soil.

The equation of the dependence of the wind resistance index of soils on the content of elementary soil particles in them was also obtained. The equation looks like this:

$$VS = 73{,}9 \cdot e^{0{,}06 \cdot ЕГЧ} \quad (2).$$

As a result of substituting equation (1) into equation (2), the indicator of anti–deflation resistance of soils (VS,%) was obtained as a function of the content of only physical clay and humus in them:

$$\mathrm{VS} = 73{,}9 \cdot \exp[0{,}06 \cdot \exp(4{,}57 - 0{,}48 \cdot \ln \mathrm{FG} - 0{,}8 \cdot \ln \mathrm{G})], \quad (3)$$

where: FG – content of physical clay in the soil;
G – humus content in the soil..

Based on calculations according to formula (3), several groups of soils were distinguished according to the indicator of anti–deflation resistance, depending on the content of physical clay and humus in them. The first most wind–resistant group of soils with an anti–deflation resistance index of 50 % or more includes soils with a physical clay content of 30–60 % and a humus content of 2.5–4.0 %.

The second group of soils (weakly wind resistant) includes soils with an anti–deflation resistance index of 20–50 %. In these soils, the content of physical clay varies in a fairly wide range of 5–60 %, and the content of humus varies within the range of 1.0–2.5 %. The third group of non–wind–resistant soils with an anti–deflation resistance index of 0–20 % includes soils with a physical clay content of 5–15 % and a humus content of 0.5–1.5 %.

Conclusions

The dependence between the anti–deflation resistance of the soil and the content of humus and the content of physical clay in the granulometric analysis of the soil was revealed. The wind resistance of the soils of the Steppe of Ukraine was classified according to these indicators, which makes it possible to simplify the determination of quantitative indicators of the deflation resistance of soils based on these standard soil indicators, which facilitates the implementation of measures that prevent deflation.

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