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Agrotechnical dusting of arable soils of Left-bank Forest-steppe and Steppe of Ukraine

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The purpose. To probe gears, dynamics and criteria of quantitative assessment of agrotechnical dusting as a component of daily blowing erosion of soils; to complete prospective calculations of possible losses of soil from blowing erosion in zone of the Northern Steppe of Ukraine on experimental plots depending on land forms, granulometric composition of top layer of soil, lumpiness, connectivity in view of protective effect of land protective belts. **Methods.** General scientific and special: field - for determination of losses of soil depending on speed of machine-tractor assembly unit, wind speed, rainfall amount; laboratory — for determination of lumpiness and pulverization of soil; mathematic-statistical - for determination of correlation between climatic, technological, genetic indexes of soils and deflationary losses. **Results.** Losses of soil is determined experimentally as a result of agrotechnical dusting, and formula is developed for their calculation. Optimum speed of machine-tractor assembly unit, as well as maps of agrotechnical dusting and potential wind-erosion losses of soils in Kharkiv oblast are determined. **Conclusions.** During machining the dynamics of lumpiness as one of main indexes of durability of soil to blowing may vary within the limits of 50% from initial. Lumpiness largely depends on production operation and speed of agricultural machinery. During field work which are connected to mechanical impact on soil it is not desirable to exceed the speed of machine-tractor assembly unit over 9,7 km/h, because of decrease of sprayed erosive corpuscles (<0,25 mm) and height of their spring (up to 2,5 m) during aggression by running apparatus and trailer gears. At speed of 12 km/h of agricultural machinery the height of spring of such corpuscles attains 8-9 m, and they are easily carried out by wind for limits of fields. At wind speed over 14 m/s field work in zone of the Northern Steppe and Left-bank Forest-steppe of Ukraine are absolutely not desirable, as losses of soil from agrotechnical dusting increase in some times.

Key words: *agrotechnical dusting, blowing erosion, rainfall amount, degraded, typical and ordinary chernozem*.

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Today, the plow of the territory of Kharkiv region exceeds the ecologically permissible limit and makes 1718868 hectares (63.5% of the total area). Arable land is represented mainly by chernozem typical and chernozem ordinary. Most of them, according to the granulometric composition, are light-lipid (more than 60%) and heavy-bulky (about 25%) soils, where particles of dust fraction predominate, which are easily crumbling and sprayed by machine-tractor aggregates and trailer mechanisms, creating considerable dusty plows of agrotechnical dusting [1] By deflationary-dangerous include about 50% of plowed areas. But, at the same time, agrotechnical dusting significantly increases the risk of deflationary processes in Kharkiv region in time and space [2-4]. The average annual rainfall in the research area is 570-580 mm per year, which is significantly different from other districts of the region. Thus, according to meteorological stations, the least rainfall is observed in the Central Lowland (with an epicenter of the city of

Balakleya less than 500 mm), and the most precipitous in areas with increased macrorelief (Velikobrunluk, Zolochivsky - more than 600 mm) [5]. The average wind speed in the region is about 4 m / s [6].

Kharkiv region expressed relief flat watershed areas that are fairly evenly dissected by river valleys and ravines. [7] Therefore, as a rule, the velocity of the dust air stream passing by the watersheds and windward slopes significantly decreases over the decrease of the relief (with the expansion of the vertical section): by beams, valleys of rivers, ponds, lakes, winding slopes exceeding 5º, and so on. Direct measurements have shown that in air from agrotechnical dust more than 90% come particles less than 0,25 mm.The particles of soil from 0.25 mm to 0.05 mm gradually settle down from the air stream (particles <0.05 mm make it fast to climb up the vertical wind turbines in higher atmospheric layers and can migrate over a considerable distance [8]. The weighted amount of particles <0 , 05 mm in the dust-air flow of agrotechnical dustings is about 1% of the total amount of soil particles.The roughness slopes of more than 5 ° make up only about 4 thousand hectares. Thus, a very small percentage of agrotechnical dustings will return to the field - about 0.4%.

An important role in the dynamics of agrotechnical dust play the speed of the machine-tractor unit and the speed of wind at the time of the technological operation. Yes, even in the 60's of the twentieth century noted an increase in the number of erosion fractions in the dust and air stream (more than 2 times) with an increase in the speed of agricultural machinery from 6.1 to 9.7 km / h. [9].

Goal. Determine the amount of deflationary losses to soil ashed typical and usual depending on the spatial distribution of rainfall and soil due to crop dusting soil; on the basis of calculations of agrotechnical dusting to draw up a map of the dynamics of agrotechnical dustmilling and potential soil losses in the Kharkiv region.

Research methodology. Calculations of agrotechnical dusting, ie raised to the air and carried out outside the soil fields, were carried out for the standard field crop rotation recommended for the Kharkiv region. The soil cultivating system was traditional, based on plow plowing for all crops except for winter crops after non-precursors, where surface processing technologies were used. The depth of soil formation was determined by the method of SS Sobolev, the number of erosive particles in the dust air stream with the help of a universal instrument - field erosion (copyright certificate UA № 51930) [10-14, 16].The presented data is the result of average annual losses after each technological operation, which are established by direct measurements.

Research results. Average annual losses of soil as a result of agrotechnical dusting on the crops of this crop rotation respectively make up: 1) black pairs - 2,33 t / ha, 2) winter wheat - 2,23 t / ha, 3) corn for grain - 4,28 t / ha , 4) spring barley 4.70 t / ha, 5) corn silage - 4.28 t / ha, 6) winter wheat - 2.23 t / ha, 7) maize for green feed - 4.28 t / ha, 8) winter wheat - 2.23 t / ha, 9) sunflower - 4.28 t / ha.

Agrotechnical dusting, increasing air polluting, enhances bacterial contamination, which adversely affects the sanitary and epidemiological state of the region. In addition, more than 1 ton of agro-technical dust is deposited on every hectare of water mirror.This significantly accelerates the sedimentation of rivers, lakes, ponds, and taking into account that along with the mineral particles of the soil fall and particles of organic and mineral fertilizers, respectively, the amount of biogenes in the reservoirs increases. Thus, for example, the amount of humus in the dust fraction is 4.8% at 5.3% of its component in chernozem ordinary heavy-gravel. In fact, removal of the most valuable, in terms of fertility, soil components is taking place.

According to our researches, with the current speed of agrotechnics more than 12 km / h, the coefficient of spraying by the engines of tractors and working bodies and wheels of agricultural machines is approaching the maximum mark (Kkr - 0,60 for chernozem ordinary average humus). At the same time, the number of erosion-dangerous particles is reduced sharply by less than 1

mm. Given that the maximum wind speed of 20% of the supply in the Kharkiv region reaches more than 20 m / s (every 5 years), the dust air stream during such periods will be easily absorbed from the resting beam of particles whose diameter is less than 1 mm, which will increase the loss of soil from agrotechnique dust many times.There is reason to say that the losses from agrotechnical dusting increase in the cube from an increase in wind speed. Thus, in just a few hours of field work at an agro-technology speed of more than 12 km / h (harrowing, seeding, discoing, etc.), at a wind speed of 14 m / s, up to 10 t / ha of erosion-hazardous fraction <1 mm of chernozem of ordinary .

It has been established that negative phenomena begin to increase with an exaggeration of the traffic velocity equal to 9.7 km / h. That is, it is an extreme force, the second derivative of the dependence of agrotechnical dusting on the speed of agricultural machines.In addition, when agrotechnics operate at speeds over 9.7 km / h, the time of contact between working bodies and the ground is reduced, and the quality of technological operations is reduced. Deep plows, sowing machines, harrows, peasers. When cultivated, the number of fallen and damaged crops increases, however, there are no more weeds weed. Vibration increases, faults become more frequent, working mechanisms are more likely to work [15]. That is, it is a question of the fact that the system of agricultural machines must be improved in the direction of increasing the width of the capture, and not the speed of movement.

The distribution of precipitation in the Kharkiv region is rather uneven: from 500 mm per year and less than and up to 600 mm and more. This significantly influences the quantitative index of agrotechnique dusting on separate areas. It imposes its imprint and diversity of soil cover with different luminosity (K%) and the coefficient of spraying (Kkr).

According to these indicators, Table 1 was prepared, where the standard black-soil with heavy rainfall of 580 mm per year was taken as a standard (Lozova District, where field surveys of agrotechnical dustings were conducted and experimentally set the number of dustings per cycle of crop rotation - the cultivation of corn for grain - 6,5 tonnes /Ha). The average agrotechnical dusting for a full cycle of crop rotation in this area is 3.3 t / ha per year.

1. Agrotechnical dustmilling in the Kharkiv region, depending on the territorial distribution of soils and precipitation (t / ha per year)

#	Soils, their lumpiness, the coefficient of spraying	Rainfall (mm / yr)										
		500	510	520	530	540	550	560	570	580	590	600
1	Chernozems ordinary K% = 35 , 0.60	4.1	4.0	3.9	3.8	3.7	3.6	3.5	3.4	3.3	3.2	3.1
2	Chernozems typical K% = 39	2.7	2.6	2.5	2.4	2.3	2.2	2.1	2.0	1.9	1.8	1.7
3	Chernozem podzoleny K% = 48	3.4	3.3	3.2	3.1	3.0	2.9	2.8	2.7	2.6	2.5	2.4

Calculations of agrotechnical dusting for Kharkiv region. Depending on the territorial distribution of soils and precipitation, taking into account the standard (Mr. Lozova), using the formula:

$$W = \frac{W_{em} \cdot K_3}{K_1 \cdot K_2}$$ where

W_e — 3.3 t / ha per year

K_1 — the lump factor, which is calculated for each soil separately separately: $K_1 = K\% / K$ *(standard);*

K_2 — rainfall factor calculated for each region of the region (from 500 mm and less than 600 mm and more): $K_2 = C_o / K$ *(standard);*

K_3 — Soil dispersion coefficient calculated:

$K = To_p / k$ *(standard)*

Thus, the scale of the parameters of the annual agrotechnical dusting per hectare of crop rotation is equal to the range of 1.7 - 4.1 t / ha. That is, depending on the area, technological logging can change more than 2 times.

Since the intensity of agrotechnical dusting is determined in general according to the administrative regions of the Kharkiv region, average calculations for each area are made, taking into account the soil cover and the amount of precipitation (map of agrotechnical dustings in the Kharkiv region - Fig. 1).

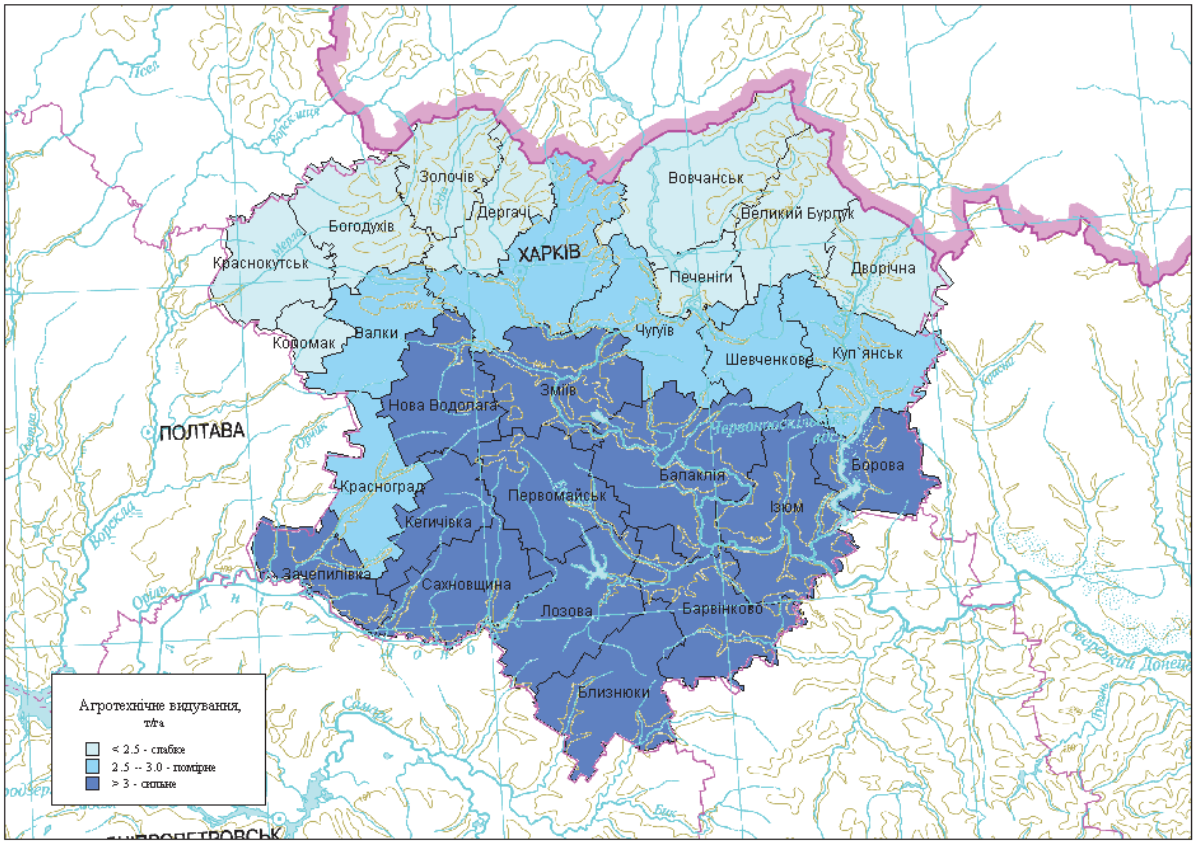

*Fig.1.DynamicsagrotechnicaldustingonKharkiv*district

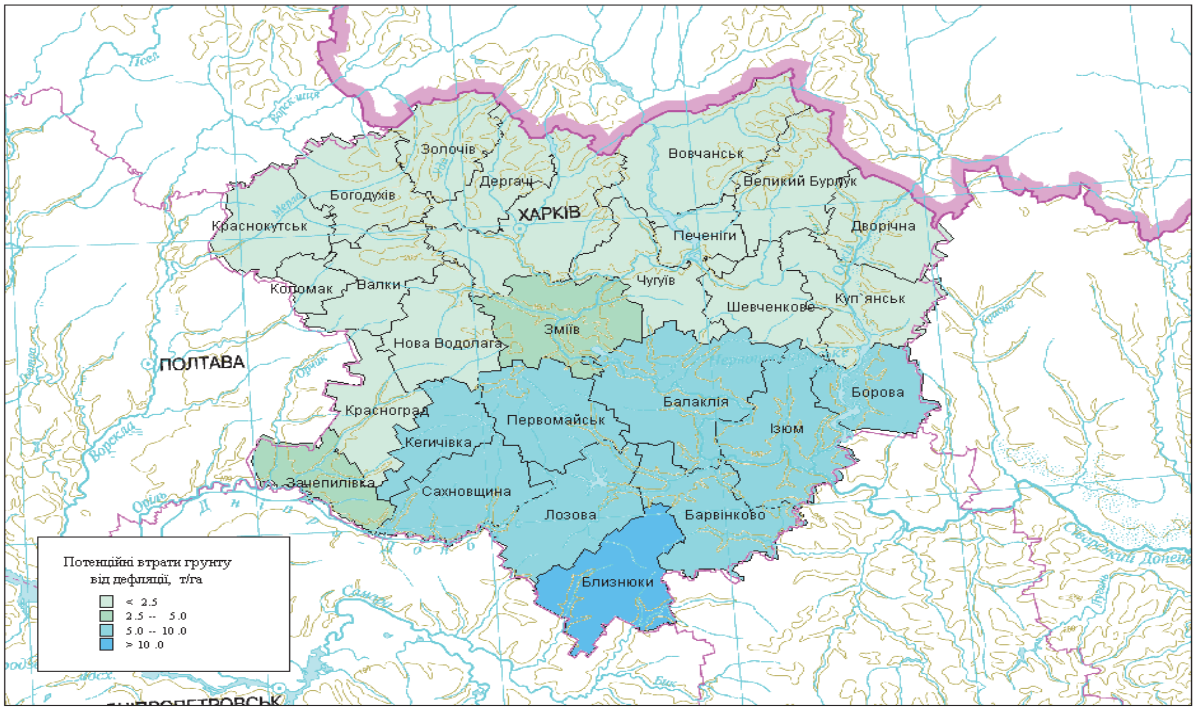

Fig.2.Potential soil losses from deflation

In addition, a mapping of potential wind-erosion soil losses from so-called black storms - that is, from modal wind erosion (Fig. 2) - is provided. Comparison of the data of these two charts shows that these data are very close, since potential losses are calculated for a wind of 20% security. In order to obtain average annual losses (50% of coverage), it is necessary to divide potential losses by factor 3. This suggests that it is unacceptable to continue to ignore the losses from agrotechnical dusting because they are on par with losses from wind erosion in our understanding of the word.

Conclusions

In field work, which is associated with mechanical impacts on the soil (harrowing, cultivating, seeding, discoing, etc.), it is not desirable to exceed the speed of the machine-tractor aggregate over 9.7 km / h. At the same time, the amount of dispersed erosion particles decreases, and the height of their leap decreases during aggression by running gear and trailer mechanisms. Thus, at an agrotechnical rate of up to 9.7 km / h, the height of the soil parcel <0.25 mm to 2.5 m, and at 12 km / h - up to 8 - 9 m, where they are easily driven by the wind outside the fields.

Taking into account the changes in the traction load while reducing the speed of agricultural machinery, it is expedient to increase the width of the trailer hoist accordingly.

At wind speed more than 14 m / s, field work related to the movement of soil in the zone of the Northern Steppe and the Left Bank forest-steppe of Ukraine, is generally not desirable to do, since the losses from agrotechnical dusting thus increase many times.

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