«Modeling of humus content in chernozem typical in conditions of long-term land use»

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Problem statement

• The main property of the soil is its fertility, which is directly related to the accumulation, content and reserves of organic matter in the soil. The humus content in the soils in the districts of the region is mainly low and average. In addition, in the conditions of the region with an increase in anthropogenic load, the processes of soil degradation increase, and therefore its fertility decreases.

• In this regard, the study of the dynamics of the humus state of soils is an urgent problem, since humus formation is a complex biochemical process, which is influenced by many different factors. The development of mathematical models of humus content depending on agrotechnical techniques in conditions of long-term land use will allow expanding monitoring studies of soils, as well as predicting changes in the humus content in soils.
In the experiment, the method of split plots was used. The placement of plots is systematic in one tier. The experience is three-factor, its repetition in space is three-fold, in time-three-fold. The acreage of the plot is 120 m², the accounting area is 100 m².

Alternation of crops in the crop rotation – grain-grass tillage: 1-year-old esparcet, 2-year-old esparcet, winter wheat, sugar beet, barley + esparcet

The soil of experimental plot of typical chernozem humus, loam medium on loess loam with the content in the arable layer of humus 5.1-5.6 %, mobile phosphorus 4.8-5.7 mg/100 g of soil exchangeable potassium 9.2-12.1 mg/100 g of soil, pH of saline extracts 5.8-6.4.

The experiment studied three methods of primary tillage:
- dump plowing tillage plow PLN-5-35 to a depth of 20-22 cm, which is preceded by disc peeling to a depth of 6-8 and 8-10 cm;
- shaft-free tillage with a plow of the «Paraplaw» type to a depth of 20-22 cm
- minimum tillage with a disc harrow BDT-7 to a depth of 10-12 cm.

Mineral fertilizers were applied in doses of N42P62K62 and N84P124K124 and manure in doses of 8 and 16 tons per 1 ha of crop rotation area. The manure was applied once per rotation of the crop rotation for sugar beet in doses of 40 and 80 t / ha.

The dependence of the humus content in typical chernozem on agrotechnical methods was estimated by means of correlation and regression analysis. Multivariate correlation and regression analysis was performed using the Excel program from the MS Office package. The reliability of the obtained results was evaluated according to the Student's criterion. Mathematical models were constructed that reflect the dependence between the humus content in typical chernozem on the methods of basic tillage, the doses of organic and mineral fertilizers, as well as the year of land use.
Conclusions

Thus, it can be concluded that the introduction of manure at a dose of 16 tons per 1 ha of crop rotation area in combination with mineral fertilizers for plowing increased the humus content in all the studied soil layers. So, in the soil layer of 0-10 cm, an excess of 0.72 and 0.58% was noted. For shaft-free tillage, it was more effective to apply a single dose of manure in combination with mineral fertilizers in doses of N_{42}P_{62}K_{62} and N_{84}P_{124}K_{124}, which increased the humus content in the 0-10 cm soil layer by 0.72 and 0.93 %, respectively. The 4-factor model of the dynamics of the humus content developed by us is more objective in determining the dependence on the applied agricultural techniques, since humus formation is a complex process that cannot be evaluated in a short time. Thus, with the completion of the fifth rotation of the crop rotation, the correlation coefficient increases almost 5 times for all the studied soil layers. As a result, these models will allow not only to evaluate the effectiveness of the use of agrotechnical techniques on the effect on the humus content in typical chernozem, but also to predict it in the future.

| soil layer, cm | 4-factor model of the dynamics of the humus*, correlation coefficient (r) |
|---------------|---------------------------------------------------------------|
| 0-10          | $y = 5,2752 + 0,0041 \ x_1 + 0,0006 \ x_2 + 0,0044 \ x_3 + 0,0306 \ x_4,$  
|               | $r = 0.7343$                                                  |
| 10-20         | $y = 5,2523 + 0,0057 \ x_1 + 0,0005 \ x_2 + 0,0034 \ x_3 + 0,0227 \ x_4,$  
|               | $r = 0.5951$                                                  |
| 20-30         | $y = 5,0746 + 0,0073 \ x_1 + 0,0005 \ x_2 + 0,0075 \ x_3 + 0,0213 \ x_4,$  
|               | $r = 0.5349$                                                  |
| 30-50         | $y = 4,4657 + 0,0213 \ x_1 + 0,0002 \ x_2 - 0,0056 \ x_3 + 0,0312 \ x_4,$  
|               | $r = 0.6001$                                                  |

* $y$ – the humus content in typical chernozem, %; $x_1$ – the dose of mineral fertilizers in the main application, c/ha; $x_2$ – the dose of cattle manure, t/ha; $x_3$ – the depth of the treated layer with the main method of processing, cm; $x_4$ – the period of land use, years
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