

Nitrogen use efficiency in long and short-term experiments of the Russian Federation

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Abstract

A study of the efficiency of nitrogen utilization by winter wheat on the basis of databases of long and short-term experiments with fertilizers located in the Non-Chernozem zone of the Russian Federation and in the Moscow region on sod-podzolic soils was carried out. It was established that in the dose range of 120-250 kg / ha in the mineral and organic-mineral fertilizer systems an optimal nitrogen balance and the most complete use of the fertilizer by plants were ensured. Smaller doses of nitrogen lead to depletion of the soil, large doses lead to pollution of agrocenoses.

Key words: long-term and short-term experiments, nitrogen fertilizers, nitrogen use efficiency.

Currently there is a great need for agricultural production in fertilizers. Especially great is the need for nitrogen sources of plants nutrition. To assess the environmental safety of the application of different nitrogen doses and improve the efficiency of its use various methods are used. Nitrogen Use Efficiency (NUE) - the ratio of introduced nitrogen and delivered with the crop is actively used in the studies of many authors [Norton R. et al. 2015, Brentrup F. et al. 2016].

Objects and methods. We conducted a study based on databases of long-term and short-term experiments. The study included long-term experiments located in the Non-Chernozem zone of the Russian Federation, covering the distribution area of sod-podzolic soils. 259 data of experimental variants of experiments with winter wheat were processed over 12 years of research (2005-2016) with a mineral and organo-mineral fertilizer systems, providing an annual application of 30 to 500 kg of nitrogen per hectare and a removal of 29 to 179 kg N / ha.

The database of short-term experiments located in the Moscow region on sod-podzolic soils contains data on the yield of winter wheat in 231 variants of the experiment for the period 1972-1989. Outputs were averaged over fertilizer doses.

Data on wheat yield, by-products and nitrogen content in them were recalculated into the nitrogen removal from the crop.

Results. The results of the study are presented in the figure.

In long-term experiments fertilizer doses up to 120 kg / ha N lead to uncompensated removal of nitrogen from the soil by plants - NUE is more than 90%. Application of more than 250 kg / ha N with fertilizers created an excess of the element, which was not used by plants for crop formation, but led to pollution of soils and adjacent territories - NUE less than 50%. The organo-mineral fertilizer system with nitrogen doses of more than 250 kg / ha did not provide the expected yield increase. When using less than 120 kg / ha of nitrogen, the uncertainty created by the variability of weather conditions does not allow for sustainable management of the nitrogen balance. In the dose range of 120-250 kg / ha in the mineral and organic-mineral fertilizer system long-term experiments ensure the optimal nitrogen balance and the most complete use of the introduced nitrogen by plants, with a yield change in the range of 2.9 - 7.3 t / ha and average nitrogen content in production 2.0%.

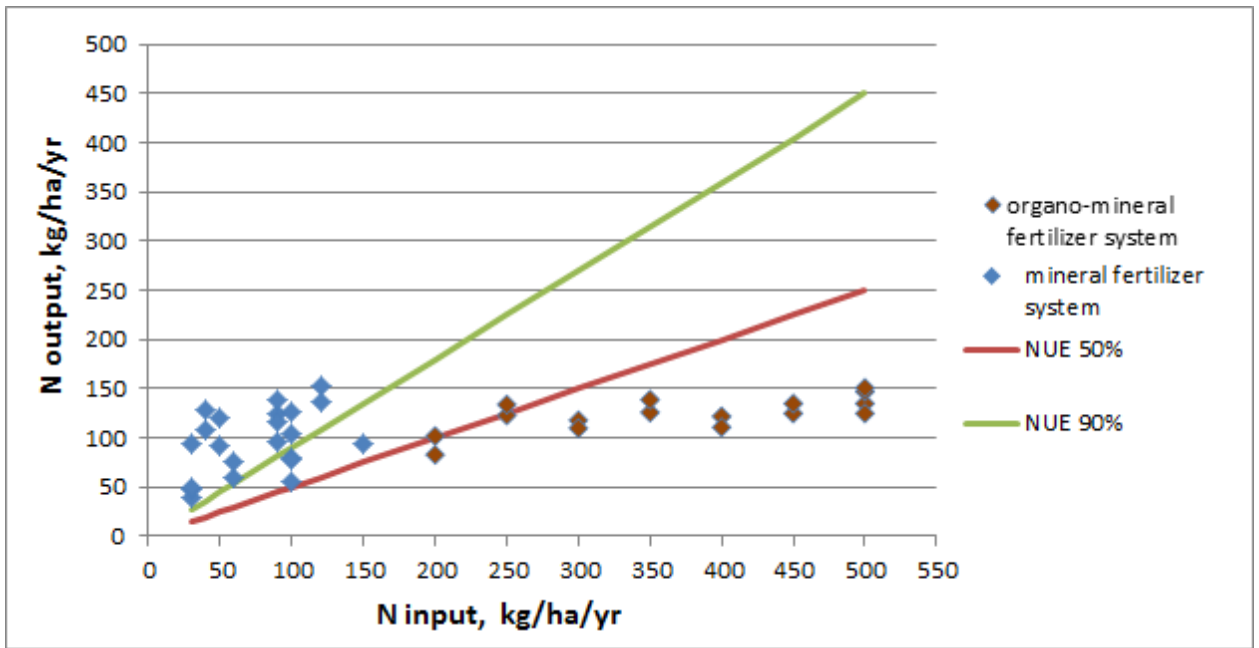


Fig. 1 Nitrogen removal with yield in long-term geo-network experiments

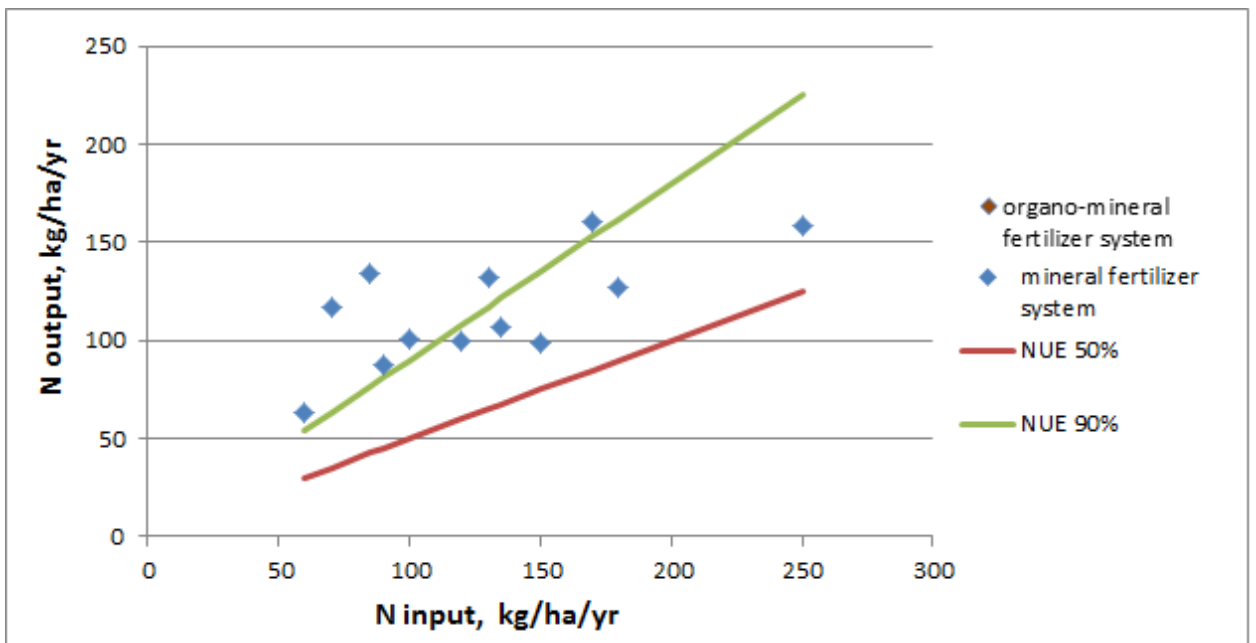


Fig. 2 Nitrogen removal with crop in short-term experiments of the Moscow region

For short-term experiments, the same patterns of nitrogen distribution were found as for modern long-term experiments: indicators of nitrogen removal by crop when nitrogen is applied from 120 to 250 kg / ha fall into the framework of optimal values. This range was achieved with varying yields of 1.1-5.2 t / ha and an average nitrogen content of 2.26%.

References

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