REFERENCES

1. Sychev V.G., Afanasiev R.A., Kirsanov G.A. et al. Possibilities of remote diagnostics of plant mineral nutrition. *Plodorodiye* [Fertility]. 2020. No. 2. Pp. 13–17. (In Russian)
2. Volosevich A.N., Trubnyakov M.D., Rybakov A.O. et al. Dynamics of agrochemical indicators of the soil depending on the use of nitrogen-containing mineral fertilizers in the cultivation of winter grain crops in the conditions of the North-West of the Russian Federation. *Izvestiya Velikolukskoy GSKHA* [News of Velikoluksk State Agricultural Academy]. 2019. No. 1. Pp. 13–26. (In Russian)
3. Prutskov F.M. *Ozimaya pshenitsa* [Winter wheat]. Moscow: Kolos, 1970. Pp. 322–327. (In Russian)
4. Afendulov K.P., Lantukhova A.I. *Udobreniya pod planiruyemyy urozhay* [Fertilizers for the planned harvest]. Moscow: Kolos, 1973. 237 p. (In Russian)
5. Pronko V.V., Yaroshenko T.M., Klimova N.F. at al. The influence of mineral fertilizers and weather conditions on the removal of nutrients by grain crops in the Volga steppe. *Plodorodiye* [Fertility]. 2020. No. 2. Pp. 17–20. (In Russian)
6. Adinyaev E.D. The dynamics of accumulation of dry matter and the consumption of basic nutrients depending on the irrigation regime of winter wheat. *Trudy Gorskogo sel'skohozyajstvennogo instituta* [Proceedings of the Gorsky Agricultural Institute]. 1974. Vol. 35. Pp. 13–23. (In Russian)
7. Petrova L.N. *Vozdelyvaniye ozimoy pshenitsy po intensivnoy tekhnologii v Stavropol'skom kraye* [Cultivation of winter wheat according to intensive technology in the Stavropol Territory]: recommendations. Stavropol: SNIISKH, 1985. Pp. 13–18. (In Russian)
8. Gubanov Ya.V., Ivanov N.N. *Ozimaya pshenitsa* [Winter wheat]. Moscow: Agropromizdat, 1988. Pp. 209–303. (In Russian)
9. Shatilov I.S. *Rukovodstvo po programmirovaniyu urozhayev* [Harvest Programming Guide]. Moscow: Rosselkhozizdat, 1996. 150 p. (In Russian)
10. Prutskov F.I., Osipov I.P. *Intensivnaya tekhnologiya vozdelyvaniya zernovykh kul'tur* [Intensive technology of cultivation of grain crops]. Moscow: Kolos, 1990. P. 166–175. (In Russian)
11. Derzhavin L.M. Features of mineral nutrition and the use of fertilizers. *Zernovoye khozyaystvo* [Grain economy]. 1985. No. 2. Pp. 7–21. (In Russian)
12. Usachev V.A., Andreev N.N., Plechov D.V. Influence of macroelements and growth regulators on the dynamics of nitrogen, phosphorus, potassium and sulfur content in winter wheat plants of the Biryuza variety in the conditions of the forest-steppe of the middle Volga region. *Vestnik Ul'yanovskoy GSKHA* [Bulletin of the Ulyanovsk State Agricultural Academy]. 2016. No. 1. Pp. 25–32. (In Russian)
13. Gudiev O.Yu., Zelenskaya T.G., Kasatkina A.O., Okrut S.V., Stepanenko E.E. Consumption of nitrogen, phosphorus and potassium by plants of various varieties of winter wheat depending on the conditions of mineral nutrition. *Zemledeliye* [Agriculture]. 2019. No. 7. Pp. 24–27. (In Russian)
14. Dospehov B.A. *Metodika polevogo opyta* [Methods of field experience]. Moscow: Agropromizdat, 1985. 352 p. (In Russian)

15. Golovachev V.I., Kirilovskaya E.V. *Metodika gosudarstvennogo sortoispytaniya sel'skokhozyaystvennykh kul'tur* [Methods of state testing of agricultural crops variety]. Kalinin: Kalinin Publishing House, 1989. No. 2. 194 p.
16. Nosatovsky A.I. *Pshenitsa* [Wheat]. Moscow: Kolos, 1965. 568 p.
17. Mineev V.G. *Udobreniya ozimoy pshenitsy* [Fertilizers of winter wheat]. Moscow: Kolos, 1973. 208 p.

Original article

CONSUMPTION OF BASIC NUTRIENTS BY WINTER WHEAT VARIETIES

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Annotation. The article presents the results of studies on the dynamics of the content of nitrogen, phosphorus and potassium in plants, the formation of a biological crop and the content of mineral nutrition elements in it, the consumption of basic nutrients by winter wheat varieties during growth and development phases. The studies were carried out in the soil and climatic conditions of the steppe zone of Kabardino-Balkaria on two varieties of winter soft wheat: Moskvich (standard) and Yuzhanka in 2012-2014. An analysis of the content of nitrogen, phosphorus and potassium in leaves and ears shows that the largest amount of these elements in the vegetative organs was noted in the initial phases of plant growth, gradually decreasing as they mature. The consumption of nutrients showed that nitrogen accumulated in plants most of all by the phase of wax ripeness, and the accumulation of phosphorus was completed by the period of milky ripeness. Potassium was consumed by plants more intensively during the period of tube growth and heading.
The content of nutrients (NPK) in grain and by-products (straw) for winter wheat varieties, as well as their removal with the harvest, has been established. The total removal of nutrients increased with the growth of the crop. In terms of the total removal of mineral nutrition elements, the Yuzhanka variety exceeds the standard, and in terms of the removal per unit of production, there were no significant differences between the varieties.

***Keywords*:** winter wheat, nutrients, productivity, mineral nutrition, nutrient removal

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