ISSN 0975-2366
https://doi.org/10.31838/ijpr/2018.10.04.032

Research Article

Early SpringSide-Dressing of Winter Wheat in the Conditionsof the OrdinaryChernozem

A. N. ESAULKO*, Y. I. GRECHISHKINA, M. S. SIGIDA, S. A. KOROSTYLEV, A. A. BELOVOLOVA
Stavropol State Agrarian University
Zootekhnicheskiy Alley, 12, Stavropol, Russia, 355017
Email id : a.n.esaulko@yandex.ru
Received: 11.07.18, Revised: 04.09.18, Accepted: 17.10.18

ABSTRACT
The article presents data on the study of various forms, doses and methods of application of fertilizers used in the early spring for feeding winter wheat grown in arid conditions of the Central Ciscaucasus. During the 10-year period of study of optimization ways of winter wheat fertilization, we have not revealed a significant difference in the effectiveness of the root fertilization and surface fertilization of winter wheat in earlyspringperiod.In years with sufficient moisture supply, the highest yield was observed in options with root fertilization of the winter wheat. We recommend the optimal dose of nitrogen for earlyspring fertilizing of winter wheat in arid conditions of ordinary chernozems to be equal to 35 kg r.a.(rate application), which provides the maximum gain in yield of winter wheat of the studied varieties by 16.3% and 17.4%, respectively.

Keywords: ordinary black soil, fertilization system, nitrogen fertilizing, fertility, winter wheat, fertilization methods, forms of fertilizer.

INTRODUCTION
In terms of crop productivity, grain varieties have great potential, which can be successfully implemented in the case of the development of an optimal system of plant nutrition based on theoretical studies, revealing the essence of the processes of formation of maximum yields of high-quality products. Optimal nitrogen fertilization is of paramount importance for the cultivation of winter crops[1].In the field conditions, plants do not absorb 30-50% of nitrogen in the year of application of nitrogen fertilizer. Just 25-45% of nitrogen from the most common nitrogen fertilizers is fixed in the soil in the organic form, while 10-30% is lost. Nitrogen utilization coefficient by plants from different nitrogen fertilizers applied before sowing turned out to be almost similar. However, the amount of nitrogen fixed in the soil in the organic form is greater, and its losses are correspondingly less from ammonium, ammonia fertilizers, and urea as compared to that from saltpeter. The loss of fertilizer nitrogen due to leaching of highly mobile soil-bound nitrates is usually low - less than 5% (usually 1-3%) of the applied quantity. Soil nitrogen, the mobilization of which is enhanced by the application of mineral fertilizers, is washed up more essentially. Thus, with the existing scale of application and average losses (20% of the applied nitrogen fertilizers), at least 2 million tons of nitrogen, the most important element of plant nutrition, is annually lost from the soil just in our country. Therefore, the regular and timely application of nitrogen at the right time gives a good opportunity for potential yield of crops with high quality of grain. Fulfillment of the optimal requirements for fertilizing is the key to the maximum yield of winter crops[2].The effectiveness of fractional application of nitrogen for winter crops has been established in many experiments. However, there is evidence in the literature concerning the advantage of a single-use nitrogen application. The analysis of the results of field experiments has shown that the positive effect of fractional nitrogen application is observed in the conditions of positive response of varieties to nitrogen fertilizers. If the variety has not responded to nitrogen fertilizer, this means that transferring part of the fertilizer toside-dressing was not effective. The effectiveness of side-dressing depends on the type of weather. The analysis of data allows concluding that at normal (sufficient) and excessive moistening of both autumn and spring-summer period in the conditions of nonchernozem zone, spring side-dressing is more effective. The efficiency of nitrogen fertilizers at the main application and spring side-dressing is sharply reduced (by 2 times or more) at a lack of precipitation in summer. The average efficiency of nitrogen application in the amount of 50% of the dose at the main fertilization of soil, and 50% of the dose in spring side-dressing of soil is close to the effectiveness of spring side-dressing except for dry autumn (when the effect of fractional application is higher)[3, 4].The natural factor determines the efficiency of nitrogen fertilizers in various soil and climatic zones, while the accumulation of mineral forms of nitrogen in the soil is due to the reserves of nutrients and moisture conditions during the growing season of grain crops[5].The role of nitrogen side-dressing of soil increases significantly in conditions of normal moisture supply and especially when irrigating[6].Side-

dressing of winter cereals is the main and mandatory technique in the technology of winter crops' cultivation. At that fully justified selection of methods and timing of application of doses, types and forms of fertilizers taking into account agrotechnical factors increases their agroecological efficiency[7-9].Thus, the recommendations for the application of spring nitrogen side-dressing of winter crops should be strictly differentiated by soil and climatic conditions,and the annual application doses should be adjusted to the moisture conditions.

Materials and Methods.

The studies were conducted during the period from 2008 to 2017 in the arid area of the Stavropol Territory in the conditions of ordinary chernozems. The research objects were two varieties of winter wheat, namely Esaul and Nota, as well as various doses and methods of nitrogen fertilizers' application at earlyspring side-dressing. The field method was used in the course of scientific experiment. Winter wheat cultivation technology was the one generally accepted for this agro-climatic zone.

Results and Discussion

The formation of maximum yield of winter wheat of good quality is possible only when the developed complex of agricultural enterprises contributes to the successful course of all vital processes in plants. The proximity of nitrogen fertilizers to seeds in many cases can reduce the yield. Therefore, one can count on a stable positive effect of row application of nitrogen fertilizers only with respect to nonacid soils containing phosphorus in the amount sufficient for the plant which is in need of nitrogen fertilizer.

To obtain high yields of winter wheat, it is necessary to create such conditions for the plant, under which the assimilation surface would reach optimal sizes and retain it for a long time under the condition of high photosynthetic activity. This is possible due to the activation of nitrogen nutrition of winter wheat. On average, over a 10-year period no significant difference in the methods of nitrogen fertilizer application in earlyspringside-dressing was revealed. Accordingly, both root and surface application methodsare quite effective at growing winter wheat in arid conditions on ordinary chernozems of the Stavropol Territory.

Table 1. The Effect Of Nitrogen Fertilizers' Doses And Methods Of Their Application On The Yield (T/Ha) Of Winter Wheat Varieties (Esaul Variety) In The Arid Zone Of The Stavropol Territory (2008-2017)

Fertilizer application method	Proportion of nitrogenkg/ha, r.a.	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Surface fertilization	0	3.41	3.2	3.17	3.48	3.15	3.87	4.0	3.85	3.52	3.75
	17.5	3.78	3.48	3.54	4.12	3.4	4.12	4.21	4.02	3.91	4.01
	35	3.92	3.61	3.78	4.31	4.2	4.51	4.73	4.84	4.73	4.89
	51.5	3.99	3.54	3.78	4.22	4.15	4.71	4.99	5.03	4.95	5.15
	69	3.8	3.41	3.92	4.30	4.1	5.09	5.49	5.67	5.15	5.25
Root fertilization	0	3.48	3.12	3.15	3.4	3.25	3.69	3.91	4.01	3.61	3.58
	17.5	3.88	3.47	3.69	4.0	3.51	4.0	4.35	4.26	4.18	4.19
	35	4.01	3.71	3.68	4.21	4.27	4.39	4.67	4.99	4.69	4.77
	51.5	3.92	3.61	3.63	4.17	4.21	4.66	4.89	5.2	4.95	5.11
	69	3.8	3.49	3.57	4.28	4.14	5.01	5.53	5.57	5.1	5.13

Nota variety had similar results in the studied 10-year period. In this regard we consider it sufficient to provide yield data for just Esaul variety (Table 1).In the options with the highest dose of nitrogen we observed certain depression in wheat growth and development, which in turn slightly reduced the yield. In the early period of plant formation, when the first three leaves appeared, the assimilating apparatus of plants was relatively poorly developed and its general synthetic activity was insignificant. Therefore, the plant needs small doses of nitrogen. Enhanced nitrogen nutrition during this period results in inhibition of growth and development of both roots and aboveground plant organs. Therefore, for better growth and development of plants, in the initial period, it is necessary to provide an enhanced phosphorus and moderate nitrogen nutrition. The effect of nitrogen fertilizer application methods on the yield of winter wheat of Esaul variety in the arid zone of the Stavropol Territory for the period 2008-2017 has been ambiguous over the research period. At that, the best results were obtained in sufficiently wet years at the options of root application of nitrogen nutrition. Stating the data obtained, we can clearly trace a direct dependence of grain yield on the dose of nitrogen fertilizer used in earlyspring soil fertilization. Table 2 shows the average yield in Esaul and Nota varieties. The yield of Nota variety was by 0.38 t/ha (surface method) and 0.36 t/ha (root method) higher than that of Esaul variety, taken as a control. On the soil fertilization options, differences between the varieties' productivity depending on fertilizer doses were also noted. The highest rates of productivity were achieved when applying nitrogen at a dose of 35 kg/ha in Esaul variety regardless of the method of fertilizer application, amounting to 4.35 t/ha and 4.33 t/ha, respectively. The influence of nitrogen nutrition on the quality of winter wheat grain

is of great interest. Earlyspring side-dressing has direct influence on the quality composition of the grain. The development of optimal nutrition of winter wheat of intense varieties is a quite urgent task for farmers of the arid zone of the Stavropol Territory. We have revealed a positive effect of nitrogen side-dressing on the quality of winter wheat grain.

Table 2. The Effect Of Nitrogen Fertilizer Doses And Methods Of Their Application On The Average Yield (T/Ha) Of Winter Wheat Varieties In The Arid Zone Of The Stavropol Territory (2008-2017)

Nitrogen doses kg/har.a., A	Fertilizer application method, B		A, LSD_{05}=0.92
	surface	root	
Esaul variety			
0	3.54	3.52	3.25
17.5	3.85	3.95	3.64
35	4.35	4.33	3.78
51.5	4.45	4.43	3.74
69	4.61	4.56	3.71
B, LSD_{05} = 0.58	3.62	3.62	LSD_{05} = 0.16 Sx, %= 4.2
Nota variety			
Nitrogen doses kg/ha r.a., A	Fertilizer application method, B		A, LSD_{05}=0.66
	surface	root	
0	3.92	3.88	3.62
17.5	4.17	4.22	3.95
35	4.70	4.75	4.25
51.5	5.14	5.07	4.27
69	5.15	5.06	4.21
B, LSD_{05} = 0.58	4.05	4.07	LSD_{05} =0.12Sx, % =4.8

Further increase in the dose of nitrogen led to an insignificant increase in the yield of winter wheat grain and was within the error of experiment. The quality of winterwheat grain increased depending on the nitrogen dose. The content of crude gluten in the grain of Esaulwinter wheat varietyat surface and rootapplication of fertilizers compared to the control increased by 1.1-4.2%. Vitreousnessand protein increased by 6-14% and 0.5-1.3%, respectively. In the options ofapplication of ammonium nitrate in doses of 35, 51.5, and 70 kg/ ha r. a., grain corresponded to the second class (Table. 3).The content of crude gluten in grain of Notawinter wheat variety atsurface and rootapplication of fertilizer increased by 0.3% and 3.9%, respectively, compared to the control. Fertilizers also had positive effect on the grain's vitreousness and protein content, the difference with the control was 1.1-12.6% and 0.2-1.2%, respectively. Grain quality of Nota varietywas worse than that of Esaul variety.

Table 3. The Effect Of Nitrogen Fertilizer Doses And Methods Of Application On The Quality Of Esaul Variety Of Winter Wheat Grain (2008-2017)

Nitrogen doses, kg/ha r.a.	Method of fertilizer application							
	Surface application				Root application			
	Crude gluten, %	Vitreousness, %	Protein, %	Gluten deformation index	Crude gluten, %	Vitreousness, %	Protein, %	Gluten deformation index
1.Control FB[1]N12P52	22.1	58	12.9	86	22.6	60	13.2	89
2. FBNaa17	23.2	62	13.4	74	24.3	64	13.6	70
3.FBNaa35	26.4	72	13.6	66	27.1	69	13.8	68
4. FBaa51.5	27.8	74	14.3	63	28.3	74	14.2	57
5.FB Naa69	28.2	70	14.4	58	28.9	74	14.5	60

[1]FB –fertilizer background

Application methods of nitrogen fertilizers had no significant impact on the quality of winter wheat varieties. Similar data were obtained forNota variety (Table 4).

Table 4. The Effect Of Nitrogen Fertilizer Doses And Methods Of Application On The Quality Of Nota Variety Of Winter Wheat Grain (2008-2017)

Nitrogen doses, kg/ha r.a.	Method of fertilizer application							
	Surface application				Surface application			
	Crude gluten, %	Vitreousness, %	Protein, %	Gluten deformation index	Crude gluten, %	Vitreousness, %	Protein, %	Gluten deformation index
1.Control FB[1]N12P52	20.1	57	10.9	96	20.6	59	11.1	92
2. FBNaa17	21.0	64	11.3	84	20.9	63	11.4	81
3. FBNaa35	22.4	66	11.5	66	22.8	66	11.7	67
4. FB aa51.5	23.5	70	11.8	60	24.1	74	12.0	60
5. FB Naa69	24.4	71	12.0	70	25.0	72	12.3	58

[1]FB – fertilizer background

Studied doses and methods of nitrogen fertilizers' application had positive impact on the formation of the crop structure, productivity, and quality of winter wheat grain. The maximum yield of Esaul variety of winter wheat was 4.47 t/ha, while that of Nota variety was 4.79 t/ha. These indicators were achieved at the surface application method which provided a dose of nitrogen equal to 69 kg/ha r.a.

Conclusion.

Thus, the studied methods of nitrogen fertilizer application had no significant impact on the productivity of winter wheat in the arid conditions of the Stavropol Territory, while the advantage of the root method of fertilizer application was not statistically valid compared to the surface method of applying mineral fertilizers for early spring side-dressing. During the 10-year period of study of fertilizers' optimization ways with respect to winter wheat, we have not revealed a significant difference in the efficiency of root and surface application methods when carrying out early spring side-dressing. In years with sufficient moisture supply, the highest yield was observed in options with root fertilization of the winter wheat. We recommend the optimal dose of nitrogen for early spring fertilizing of winter wheat in arid conditions of ordinary chernozems to be equal to 35 kg r.a., which provides the maximum gain in yield of winter wheat of the studied varieties by 16.3% and 17.4%, respectively.

Acknowledgements.

Academic staff of the Chair of agrochemistry and plant physiology expresses deep gratitude to Professor V.I. Trukhachev, Corresponding Member of the Russian Academy of Sciences, Rector of the Stavropol State Agrarian University, for equipping the Agrochemical analysis laboratory at the Department of agrobiology and land recourses with the advanced instrumentation, which was necessary to conduct the present research.

References

1. Esaulko, A. N., Salenko, E. A., Sigida, M. S., Korostylev, S. A., & Golosnoy, E. V. (2015). Agrochemical Principles of Targetting Winter Wheat Yield on Leached Chernozem of the Stavropol Elevation. Biosciences Biotechnology Research Asia, 12(1), 301-309.
2. Esaulko, A. N., Salenko, E. A., Sigida, M. S., Golosnoy, E. V., & Gurueva, A. Y. (2016). Effect of increasing doses of mineral fertilizers on development of root rot pathogen fusarium in crops winter wheat. Research Journal of Pharmaceutical, Biological and Chemical Sciences, 7(3), 2574-2577.
3. Shah, B. N., Raiyani, K. D., & Modi, D. C. (2011). Antiurolithiatic Activity Studies of Momordica charantia Linn. Fruits. International Journal of Pharmacy Research and Technology, 1(1), 06-11.
4. Esaulko, A. N., Grechishkina, Y. I., Sigida, M. S., Korostilev, S. A., & Golosnoi, E. V. (2016). The Influence of Fertilizer Systems on the Content of Various Forms of Potassium and Nutrition Mode of Humus. Oriental journal of chemistry, 32(6), 3189-3199.
5. Esaulko, A. N., Ozheredova, A. Y., Sigida, M. S., Voskoboinikov, A. V., & Podkolzin, O. A. (2017). Introduction of calculated doses of mineral fertilizers to achieve maximum productivity of winter wheat varieties on chernozem leached Stavropol

upland. Research Journal of Pharmaceutical, Biological and Chemical Sciences, 8(6), 778-781.

6. Esaulko, A. N., Grechishkina, Y. I., Sigida, M. S., Golosnoi, E. V., & Korostilev, S. A. (2017). The Content of Various Forms of Phosphorus in Leached Chernozem Due To Application of Fertilizer Systems. Journal of Pharmaceutical Sciences and Research, 9(12), 2498-2503.
7. Belovolova, A. A., Gromova, N. V., Salenko, E. A., Ageev, V. V., & Podkolzin, A. I. (2017). Accumulation Ions of Salts and Nutrients in Plants Due to Soil Salinity and Changes in Mineral Nutrition. RESEARCH JOURNAL OF PHARMACEUTICAL BIOLOGICAL AND CHEMICAL SCIENCES, 8(6), 800-804.
8. Dorozhko, G. R., Petrova, L. N., Lobankova, O. Y., Lysenko, I. O., & Mandra, Y. A. (2017). The Influence of Cultivation Technologies and Fertilizer Systems on The Productivity of Winter Wheat on Leached Chernozem. RESEARCH JOURNAL OF PHARMACEUTICAL BIOLOGICAL AND CHEMICAL SCIENCES, 8(6), 819-823.