



ВЛИЯНИЕ СПОСОБОВ ОБРАБОТКИ ПОЧВЫ НА УРОЖАЙНОСТЬ ОЗИМОЙ РЖИ СОРТА СУДАРУШКА

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Изложены результаты изучения элементов технологии возделывания нового сорта озимой ржи Сударушка. Исследования проходили в 2019, 2020 гг. в условиях подтаежной зоны Томской области. Дана оценка влияния способов обработки почвы, а также воздействия удобрения гуминового из торфа Гумостим на урожайность озимой ржи Сударушка. Почвы опытного участка кислые (рН 4,3) дерново-подзолистые супесчаного механического состава. Пахотный горизонт характеризуется низким (1,5%) содержанием гумуса, слабой обеспеченностью нитратным азотом (0,2 мг/100 г), средней (19,2) – подвижным фосфором и обменным калием (7,1), высоким (11,0 мг/100 г) содержанием подвижного алюминия. Схема опыта включала четыре варианта обработки почвы: вспашка пара ПЛН-4-35 + культивация КПН-4,2, посев без прикатывания и с прикатыванием; дискование БДМК-2,8 + культивация КПН-4,2, посев без прикатывания и с прикатыванием. Обработку удобрением гуминовым из торфа Гумостим в концентрации 0,001% проводили по вегетации в фазе начала выхода в трубку. Средняя урожайность озимой ржи сорта Сударушка за годы исследований составила 4,66 т/га в варианте с дискованием, последующей культивацией перед посевом и дальнейшим посевом с прикатыванием, что на 0,34 т/га выше, чем при традиционном способе обработки почвы. Применение удобрения гуминового из торфа Гумостим на холодных дерново-подзолистых почвах позволило в среднем по опыту получить урожайность озимой ржи 4,31 т/га, что на 0,39 т/га выше, чем без удобрения.

Ключевые слова: озимая рожь Сударушка, урожайность, способы обработки почвы, Гумостим

INFLUENCE OF TILLAGE METHODS ON THE YIELD OF WINTER RYE VARIETY SUDARUSHKA

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The results of studying the elements of the technology of cultivation of a new variety of winter rye Sudarushka are presented. The research took place in 2019, 2020 in the sub-taiga zone of the Tomsk region. The impact of soil cultivation methods as well as the impact of humic fertiliser from peat Gumostim on the yield of winter rye Sudarushka is evaluated. The soils of the experimental plot are acidic (pH 4.3) soddy-podzolic loamy sandy loam. The arable horizon has a low humus content (1.5%), a low (0.2 mg/100g) content of nitrate nitrogen, a medium content of mobile phosphorus

(19.2) and exchangeable potassium (7.1) and a high (11.0 mg/100g) content of mobile aluminium. The scheme of the experiment included four variants of cultivation: ploughing of fallow lands with PLN-4-35 + cultivation KPN-4,2, sowing without packing and with packing; disking with BDMK-2,8 + cultivation KPN-4,2, sowing without packing and with packing. Treatment with humic fertilizer from peat Gumostim at a concentration of 0.001% was carried out during the growing season in the beginning phase of the leaf-tube formation. The average yield of winter rye in the variety Sudarushka during the years of research was 4.66 t/ha in the variant with disking, subsequent cultivation before sowing and further sowing with packing, which is 0.34 t/ha higher than with the traditional method of soil cultivation. The application of humic fertilizer from peat Gumostim on cold sod-podzolic soils enabled the average yield of winter rye to be 4.31 t/ha y, which is 0.39 t/ha higher than without the fertilizer.

Keywords: winter rye Sudarushka, yield, soil cultivation methods, Gumostim

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Конфликт интересов

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Conflict of interest

The authors declare no conflict of interest.

INTRODUCTION

Winter rye is a strategic food grain crop in Russia, the most plastic in its range and the most adaptable for regions with difficult natural and climatic conditions. Only rye can withstand the lowest temperature at the depth of the tillering node down to -23 °C. It is widely regarded as a low economic risk crop, especially in areas with poor soils. Rye is mainly distributed in areas with sandy and clay soils with low fertility and high acidity, where other cereal crops have lower yields [1-3].

The use of a set of agronomic measures is aimed at obtaining high and sustainable crop yields and should be based on their biological characteristics, which contributes to the manifestation of the maximum potential of the variety [4].

One of the ways to increase rye yields is proper tillage, which should solve a set of problems depending on the forecrop, soil, climatic and hydrothermal conditions, phytosanitary state of the fields. To save material and energy resources it is necessary to minimize the number of technological operations and at

the same time to ensure optimal conditions for plant development.

There are different opinions and conclusions in the scientific literature about the impact of different tillage technologies on crop yields [5-7]. According to some scientists [8-10], the non-mouldboard system compared to the mouldboard system worsens the fertility of the arable layer. A number of authors note an increase in the yield of crops grown by non-mouldboard (compared to plowing) against the background of high doses of mineral fertilizers [11].

In the sub-taiga zone on cold sod-podzolic soils, a system of tillage with obligatory seed rolling of crops is adopted [12]. The rolled soil increases moisture reserves, stimulates the processes of seed germination.

The purpose of the study - to develop elements of cultivation technology of the new variety of winter rye Sudarushka.

Edaphic stresses, biotic factors and climatic conditions limiting high yields of crops in the West Siberian region allow the most complete assessment of the degree of influence of agro-

onomic practices on the yield, in particular of winter rye. In previous experiments, the sowing dates and seeding rates of winter rye varieties Sudarushka were determined ^{1,2}. The objective of the present study was to determine the rational methods of tillage during cultivation of the variety.

MATERIAL AND METHODS

The study of agrotechnics of cultivation of the new variety of winter rye Sudarushka was conducted in 2019, 2020 on the fields of agro-technical crop rotation of the Narym Department of Breeding and Seed Production of the Siberian Research Institute of Agriculture and Peat - a branch of SFSCA RAS.

Soils of the experimental site are acidic (pH 4.3) sod-podzolic loamy sandy loam texture. The arable horizon is characterized by low (1.5%) humus content, low supply of nitrate nitrogen (0.2 mg/100 g), medium supply of mobile phosphorus (19.2) and exchangeable potassium (7.1), high content of mobile aluminum (11.0 mg/100 g) [13].

Winters of 2019/20 and 2020/21 were severe (down to -45 °C) and prolonged with significant (up to 110 cm) snow blanket laying for 175-186 days. The meteorological conditions of the growing seasons differed significantly in the amount of precipitation and temperature regime.

A peculiarity of the growing season 2019 was the late onset of spring. Disintegration of the snow blanket occurred on 16 April, but due to very cool weather, the resumption of the growing season was noted only on 5 May. The shooting and earing stages were delayed until 10 June and 3 June, respectively. Rye flowering did not start until late June. Moisture deficit was observed during the whole vegetation period, especially during grain ripening, which affected the yield.

In 2020, the snow blanket disintegrated on 11 April and vegetation resumed on 19 April. The shooting and earing took place in a short period of time. The flowering of rye was observed on 7 June. Sufficient moisture supply and warm weather allowed the formation of a fair yield.

The material for the study was a new variety of winter rye Sudarushka, which was included in the State Register of Selection Achievements in the West Siberian region in 2021; it is protected by a patent³.

The variety is medium-late maturing, with a growing season of 340-350 days. The plant height is 106-110 cm. Resistance to lodging is high. It belongs to the varieties of extensive type, is characterized by high winter hardiness, medium resistance to brown rust and powdery mildew, less affected by snow mold. In competitive variety trials, the average yield for 2015-2017 was 5.1 tons, which is 0.41 tons higher than that of the released variety Petrovna. The activity of alpha-amylase is low, the fall number - 241. Grain unit is 699 g/l. The variety has a high stable productivity and the ability to maintain an optimal density throughout the growing season.

The scheme of experiments was to study the effect of methods of cultivation and humic fertilizer from peat Gumostim on the yield of winter rye varieties Sudarushka.

The experiments included four variants of tillage:

- fallow plowing PLN-4-35 + cultivation KPN-4,2, seeding with rolling;
- fallow plowing PLN-4-35 + cultivation KPN-4,2, seeding without rolling;
- disking BDMK-2,8 + cultivation KPN-4,2, seeding with rolling;
- disking BDMK-2,8 + cultivation KPN-4,2, seeding without rolling.

¹Brazhnikov P.N. Influence of sowing dates and seeding rates on the yield of winter rye variety Sudarushka. Optimization of the breeding process - a factor of stabilization and growth of crop production in Siberia: Proceedings of the International Conference Krasnoyarsk, 2019. pp. 200-203.

²Brazhnikov P.N. Elements of cultivation technology of a new variety of winter rye Sudarushka in the northern taiga zone. Agrarian science to agricultural production of Siberia, Mongolia, Kazakhstan, Belarus and Bulgaria: collection of scientific papers. 22nd International Scientific and Practical Conference Yakutsk, 2019. pp. 17-18.

³Patent 11665 (Russian Federation). Winter rye Sudarushka. P.N. Brazhnikov, A.B. Sainakova. Siberian Federal Research Center for Agrobiotechnology RAS; No 75001; publ. 18.05.2021.

In four replications out of eight at the onset of stem elongation phase, the crops were sprayed with Gumostim designed to increase crop yields and quality. The fertilizer contains humic, carboxylic acids and amino acids, including indispensable, as well as macronutrients - nitrogen, phosphorus, calcium, iron, trace elements - copper, zinc, manganese, vitamins - A, B1, B2, B5, B6, B12, C, E. The content of the main active ingredient - 1% humic acids. For foliar feeding of plants, we used 0.001% solution of the drug⁴.

Location of the plots in the experiments is systematic, the accounting area of the plot is 20 m². Seeding was carried out on August 15 with central seeding planter SKS-6-10 with seeding rate of 5.5 million germinated seeds/ha. Fallow plowing PLN-4-35 + cultivation KPN-4,2 with rolling was taken as a control. Pressing was carried out by smooth rollers KVG-1,4, spraying - with a Palisad backpack sprayer (12 l) at a rate of 200 l/ha. Under pre-sowing cultivation nitrogen-phoska (N16P16K16) was applied at a dose of 50 kg/ha in physical weight.

Experimental material was statistically processed according to B.A. Dospekhov⁵ using application software package⁶.

RESULTS AND DISCUSSION

Under unfavorable conditions of 2019 the variant with traditional tillage - plowing with cultivation and rolling of crops (control) had the advantage. Variant with non-mouldboard tillage (disking, cultivation + rolling) was the most productive in the optimal conditions of the growing season 2020, the average yield of winter rye Sudarushka was 5.50 t/ha (+0.64 t/ha, NCR05 = 0.25). On the average for 2 years the yield at the variant of tillage "disking BDMK-2,8 + cultivation KPN-4,2, seeding with rolling" also reliably exceeded the control (+0.34 t/ha, NCR05 = 0.15).

Spraying of crops with Gumostim solution (0,001%) in the phase of stem elongation in all variants increased rye yield by 0,20-0,57 t/ha in 2019 and by 0,30-0,50 t/ha in 2020. Increases are significant in the variant disking BDMK-2,8 + cultivation KPN-4,2, seeding with rolling (+0.57 t/ha, NSR05 = 0.47) in unfavorable con-

Урожайность сорта Сударушка при разных способах обработки почвы и внекорневой подкормке Гумостимом, т/га
Yield of the Sudarushka variety with different methods of soil cultivation and foliar feeding with Gumostim, t/ha

Option	2019		2020		Average for 2 years	± to the control
	Without подкормки	Gumostim	Without подкормки	Gumostim		
Plowing, cultivation, seeding with rolling	3,68	3,88	4,62	5,12	4,32	Control
Plowing, cultivation, seeding without rolling	2,39	2,83	4,25	4,66	3,53	-0,79
Disking, cultivation, seeding with rolling	3,57	4,14	5,32	5,68	4,66	+0,34
Disking, cultivation, seeding with rolling	3,04	3,47	4,50	4,80	3,95	-0,37
LSD ₀₅	0,254	0,476	0,264	0,216	0,151	0,322

⁴Patent 2530145C1 (Russian Federation). Method of obtaining plant growth stimulant from lowland peat. L.V. Kasimova, A.E. Donkin, A.A. Krasnoschekov, V.A. Klimovich; Siberian Research Institute of Agriculture and Peat RASKhN; № 2013122952/13; Application. 21.05.2013; publ. 10.10.2021.

⁵Dospekhov B.A. Methodology of field experiment (with the basics of statistical processing of research results). Moscow: Agropromizdat, 1985. 416 p.

⁶Sorokin O.D. Applied statistics on the computer. Novosibirsk, 2007 p.

ditions in 2019 and in all variants in favorable 2020 (NSR05 = 0.22). On average for 2 years, the yield in all variants with Gumostim treatment was significantly higher than the variants without treatment (+0.35-0.46 t/ha, NCR05 = 0.11).

Two-year experiments confirmed the necessity of such an agricultural technique as rolling the soil: in all variants without rolling the crops rye yield was significantly lower than the control (see the table).

CONCLUSIONS

1. The average yield of winter rye Sudarushka in 2019, 2020 was 4.66 t/ha in the variant with disking, followed by cultivation before seeding and further seeding with rolling, which is 0.34 t/ha higher than with the traditional method of tillage.

2. Application of humic fertilizer from peat Gumostim on cold sod-podzolic soils allowed to get an average yield of 4.31 t/ha of rye in the experiment, which is 0.39 t/ha higher than without the fertilizer.

СПИСОК ЛИТЕРАТУРЫ

1. Уткина Е.И., Кедрова Л.И. Зимостойкость озимой ржи: проблемы и решения // Аграрная наука Евро-Северо-Востока. 2018. № 62 (1). С. 11–18. DOI: 10.30766/2072-9081.2018.62.1.11-18.
2. Сысуюев В.А. Комплексные научные исследования по озимой ржи – важнейшей национальной и стратегической зерновой культуре РФ // Достижения науки и техники АПК. 2012. № 6. С. 8–11.
3. Жученко А.А. Потенциальная продуктивность и экологическая устойчивость ржи // Агропродовольственная политика. 2012. № 2. С. 19–24.
4. Сдобников С.С. Обработка почвы, условия питания растений и использования удобрений в интенсивном земледелии // Параметры плодородия основных типов почв: монография. М.: Агропромиздат, 1988. С. 44–56.
5. Колкова И.А. Влияние обработки почвы на плодородие и агрофизические свойства // Молодой ученый. 2017. № 29 (163). С. 39–42.
6. Плещачёв Ю.Н., Кошечев И.А., Кандыбин С.С. Влияние способов основной обработки почвы на урожайность зерновых культур //

Вестник Алтайского государственного аграрного университета. 2013. № 1. С. 23–26.

7. Перфильев Н.В., Вьюшина О.А., Власенко А.Н. Эффективность систем основной обработки темно-серой лесной почвы при возделывании ячменя // Сибирский вестник сельскохозяйственной науки. 2021. № 51 (1). С. 11–17. DOI: 10.26898/0370-8799-2021-1-1.
8. Пегова Н.А., Владыкина Н.И. Изменение показателей плодородия и продуктивности дерново-подзолистой почвы при разных системах обработки // Достижения науки и техники АПК. 2016. Т. 30. № 6. С. 72–76.
9. Куликова А.Х., Ерофеев С.Е. Агроэкологическая оценка основной обработки почвы под яровую пшеницу // Земледелие. 2003. № 2. С. 16–17.
10. Цыбулько Н.Н., Ермоленко А.В., Лазаревич С.С. Влияние обработки дерново-подзолистых супесчаных почв разной степени гидроморфности на влагообеспеченность и урожайность сельскохозяйственных культур // Мелиорация. 2012. № 1. С. 103–118.
11. Беседин Н.В., Сахн-Вальд Ф.В., Котельникова М.Н. Влияние различных способов обработки почвы и систем удобрений на урожайность озимой пшеницы в условиях серых лесных почв Курской области // Главный агроном. 2019. № 12. С. 12–16.
12. Системы земледелия Томской области на ландшафтной основе: монография / под ред. В.К. Каличкина Томск, 2018. Ч. 1. 266 с.
13. Анкудович Ю.Н., Макарикова Р.П., Наумова Н.Б., Савенков О.А., Вервайн О.Д. Изменение содержания кислоторастворимой формы элементов в агродерново-подзолистой почве при внесении удобрений в длительном полевом опыте с севооборотом // Проблемы агрохимии и агроэкологии. 2013. № 1. С. 16–21.

REFERENCES

1. Utkina E.I., Kedrova L.I. Winter hardiness of winter rye: problems and solutions. *Agrarnaya nauka Euro-Severo-Vostoka = Agricultural Science Euro-North-East*, 2018, no. 62 (1), pp. 11–18. (In Russian). DOI: 10.30766/2072-9081.2018.62.1.11-18.
2. Sysuev V.A. Comprehensive scientific research on winter rye-the most important national and strategic grain crop of the Russian Federation. *Dostizheniya nauki i tekhniki APK = Achievements of Science and Technology of the Agro-Industrial Complex*, 2012, no. 6, pp. 8–11. (In Russian).

3. Zhuchenko A.A. Potential productivity and environmental sustainability of rye. *Agroproduktivnost' i ekologicheskaya politika. Agropromyshlennaya politika = Agri-food policy*, 2012, no. 2, pp. 19–24. (In Russian).
4. Sdobnikov S.S. *Soil treatment, conditions of plant nutrition and the use of fertilizers in intensive agriculture. Fertility parameters of the main soil types*. Moscow, Agropromizdat Publ., 1988, pp. 44–56. (In Russian).
5. Kolkova I.A. Influence of tillage on fertility and agrophysical properties. *Molodoi uchenyi = Young scientist*, 2017, no. 29 (163), pp. 39–42. (In Russian).
6. Pleskachev Yu.N., Koshchev I.A., Kandybin S.S. The influence of basic tillage methods on the yield of grain crops. *Vestnik Altaiskogo gosudarstvennogo universiteta = Bulletin of the Altai State University*, 2013, no. 1, pp. 23–26. (In Russian).
7. Perfil'ev N.V., V'yushina O.A., Vlasenko A.N. Efficiency of systems of basic processing of dark gray forest soil in the cultivation of barley. *Sibirskii vestnik sel'skokhozyaistvennoi nauki = Siberian Bulletin of Agricultural Science*, 2021, no. 51 (1), pp. 11–17. (In Russian). DOI: 10.26898/0370-8799-2021-1-1.
8. Pegova N.A., Vladykina N.I. Changes in the indicators of fertility and productivity of sod-podzolic soil under different treatment systems. *Dostizheniya nauki i tekhniki APK = Achievements of Science and Technology of the Agro-Industrial Complex*, 2016, vol. 30, no. 6, pp. 72–76. (In Russian).
9. Kulikova A.Kh., Erofeev S.E. Agroecological assessment of the main tillage for spring wheat. *Zemledelie = Zemledelie*, 2003, no. 2, pp. 16–17. (In Russian).
10. Tsybul'ko N.N., Ermolenko A.V., Lazarevich S.S. Influence of processing of sod-podzolic sandy loam soils of different degrees of hydromorphy on the moisture supply and yield of agricultural crops. *Melioratsiya = Land reclamation*, 2012, no. 1, pp. 103–118. (In Russian).
11. Besedin N.V., Sakhn-Val'd F.V., Kotelnikova M.N. Influence of various tillage methods and fertilizer systems on winter wheat yield in the conditions of gray forest soils of the Kursk region. *Glavnyi agronom = Chief Agronomist*, 2019, no. 12, pp. 12–16. (In Russian).
12. *Agricultural systems of the Tomsk region on a landscape basis* / edited by V.K. Kalichkin. Tomsk, 2018, Part 1. 266 p. (In Russian).
13. Ankudovich Yu.N., Makarikova R.P., Naumova N.B., Savenkov O.A., Vervain O.D. Changes in the content of the acid-soluble form of elements in agrodernovo-podzolic soil when applying fertilizers in a long field experiment with crop rotation. *Problemy agrokhimii i agroekologii = Problems of Agrochemistry and Agroecology*, 2013, no. 1, pp. 16–21. (In Russian).

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