УДК 633.152(470.630)

4.1.1. Общее земледелие и растениеводство (биологические науки, сельскохозяйственные науки)

ДИНАМИКА АГРОФИЗИЧЕСКИХ ПОКАЗАТЕЛЕЙ ПОЧВЫ ПОД ПОСЕВАМИ ОЗИМОЙ ПШЕНИЦЫ ПРИ МИНИМИЗАЦИИ ОСНОВНОЙ ОБРАБОТКИ ПОЧВЫ

Кравченко Роман Викторович
д. с.-х. н., доцент
РИНЦ SPIN-код: 3648-2228
roma-kravchenko@yandex.ru

Лучинский Сергей Ильич
канд с.-х. н, доцент

Амзаева Яна Борисовна
аспирант
Кубанский государственный аграрный университет, Россия, 350044, Краснодар, Калинина, 13

Статья посвящена анализу динамики агрофизических показателей почвы под посевами озимой пшеницы сорта Тимирязевка 150 при минимизации основной обработки почвы в 11-и польном зерно-пропашном севообороте. Схема опыта (прием основой обработки почвы). 1. Дисковое лущение (10-12 см). 2. Вспашка (20-22 см). 3. Чизелевание на 20-22 см. 4. Нулевая обработка почвы. Агротехника, учеты и наблюдения проводили в соответствии с общепринятыми для данной культуры и зоны возделывания рекомендациями и методиками. Предшествующая культура – соя. Исследованиями установлено, что наименьшая плотность и твёрдость почвы наблюдалась на варианте с отвальной вспашкой (контроле), а самые высокие значения этих показателей были на участках с нулевой обработкой почвы. Дисковое лущение занимало промежуточное место. Отвальная основная обработка обеспечивает наиболее оптимальную структуру почвы, лучшую на 5,1 % по сравнению с глубоким рыхлением без оборота пласта, на 17,6 % по сравнению с мелкой обработкой и на 19,0 % по сравнению с нулевой обработкой почвы

Ключевые слова: ОЗИМАЯ ПШЕНИЦА, ОБРАБОТКА ПОЧВЫ, ПЛОТНОСТЬ, ТВЕРДОСТЬ, АГРЕРАТНЫЙ СОСТАВ ПОЧВЫ

http://dx.doi.org/10.21515/1990-4665-199-007

UDC 633.152(470.630)

4.1.1. General agriculture and crop production (biological sciences, agricultural sciences)

DYNAMICS OF AGROPHYSICAL INDICATORS OF THE SOIL UNDER WINTER WHEAT CROPS WHILE MINIMIZING THE MAIN TILLAGE

Kravchenko Roman Viktorovich
Dr.Sci.Agr., assistant professor
RSCI SPIN code: 3648-2228

Luchinskiy Sergey Ilich
Cand.Agr.Sci., assistant professor

Amzaeva Yana Borisovna
postgraduate student
Kuban State Agrarian University, Krasnodar, Russia 350044, Kalinina, 13

The article is devoted to the analysis of the dynamics of agrophysical indicators of soil under crops of winter wheat of the Timiryazevka 150 variety when minimizing the main tillage in an 11-field grain-row crop rotation. Scheme of the experiment (basic tillage method). 1. Disc peeling (10-12 cm). 2. Plowing (20-22 cm). 3. Chiselization by 20-22 cm. 4. Zero tillage. Agricultural technology, records and observations were carried out in accordance with the generally accepted recommendations and methods for this crop and cultivation zone. The previous crop is soybean. Research has established that the lowest density and hardness of the soil was observed in the variant with moldboard plowing (control), and the highest values of these indicators were in areas with zero tillage. Disc peeling occupied an intermediate place. Main moldboard tillage provides the most optimal soil structure, better by 5.1% compared to deep loosening without soil rotation, by 17.6% compared to shallow tillage and by 19.0% compared to zero tillage

Keywords: WINTER WHEAT, SOIL TILLAGE, SOIL MOISTURE, PRODUCTIVE MOISTURE

Introduction

In world production among grain crops, wheat ranks third. Wheat plays an important role in ensuring food security throughout the world, as it is the leading source of calories and vegetable protein in human food. Flour obtained from wheat grains is the main raw material for the production of bakery and pasta products. Among the crops currently cultivated in Russia, winter wheat occupies the leading position in terms of sown area. Wheat production has increased over time in both area and grain production. From year to year, despite unfavorable seasons and weather conditions (whims), hectares of sown area remain at a stable level, and in some places even increase in some regions. The relative stability of growing winter wheat is ensured by the correct and latest technology for its cultivation, thanks to which it is possible to obtain the highest yields in agriculture. The issue of selecting the optimal technology for growing winter wheat remains relevant today for many farmers from all over the country[1-5].

Due to the large amount of information on the influence of shallow mulch tillage and direct sowing on the formation of winter wheat productivity in the Krasnodar Territory, as well as the contradictory attitude of different researchers to tillage, it is necessary to continue research in this direction in order to determine the optimal option for loosening arable land or no processing. The purpose of these studies is to identify a technology for growing agricultural crops that ensures maximum growth, development and grain yield with a minimum volume of production costs and high production profitability. Including determining the influence of two different methods of basic soil cultivation: plowing and direct sowing of crops while leaving crop residues of the predecessor on the yield of winter wheat in the conditions of the Central zone of the Krasnodar Territory[6-10].

The purpose of the work is a comprehensive analysis of the dynamics of humidity and reserves of productive moisture against the background of various soil treatments that can ensure the highest possible crop yield while optimizing

the main soil treatment together with correctly selected rates of mineral fertilizer.

Material and object of research

The experiment we are planning was carried out in 2021-23 on an experimental field, which is located on the territory of the Kuban educational farm. Leached chernozem is the main part of the soil cover, in the area of which an experimental study was carried out.

The experiment studied the dynamics of agrophysical indicators of soil under crops of winter wheat variety Timiryazevka 150 while minimizing the main tillage in an 11-field grain-row crop rotation.

Scheme of the experiment (basic tillage method).

1. Disc peeling (10-12 cm). 2. Plowing (20-22 cm). 3. Chiselization by 20-22 cm. 4. Zero tillage.

Agricultural technology, records and observations were carried out in accordance with the generally accepted recommendations and methods for this crop and cultivation zone. The previous crop is soybean.

Research results

Soil density plays an important role and has a noticeable impact on agrophysical indicators and soil regimes, such as water-air and heat; both very loose and very dense soil negatively affect the growth and development of winter wheat plants. When the soil density is less than 1.0 g/cm3, severe drying of the soil occurs, since the number of non-capillary pores prevails over capillary ones. As a result of soil self-compaction, plant roots break off, and with a density greater than 1.40 g/cm3, root growth is hampered, soil cracking increases, moisture evaporates more, and the microbiological activity of the soil decreases.

In our experience, soil density increased towards the end of the growing season and differed markedly among the main tillage options (Table 1)

During the spring tillering phase, the soil density in the arable layer varied from 1.16 g/cm3 in plowing to 1.31 g/cm3 in the option without tillage. In terms of disc tillering and chiseling, it was the same. In all studied variants, soil density was within the optimal range, which had a beneficial effect on the growth conditions of winter wheat.

Table 1 - Dynamics of soil density depending on the method of its main treatment, g/cm3

Tillage	Soil layer, cm			
	0–10	10–20	20–30	0–30
tillering in spring				
Disc peeling (k)	1.13	1.26	1.29	1.23
Plowing	1.10	1.13	1.25	1.16
Chiseling	1.18	1.19	1.28	1.22
No-till	1.28	1.33	1.32	1.31
heading				
Disc peeling (k)	1.28	1.29	1.30	1.31
Plowing	1.18	1.19	1.28	1.22
Chiseling	1.19	1.24	1.30	1.24
No-till	1.28	1.33	1.35	1.32
full ripeness				
Disc peeling (k)	1.29	1.31	1.36	1.32
Plowing	1.27	1.28	1.30	1.28
Chiseling	1.27	1.30	1.33	1.30
No-till	1.32	1.37	1.42	1.37

During the heading phase, soil density in all variants did not increase significantly compared to the first period of determination, which was due to the large amount of precipitation that fell during this period. In the control and the option where sowing was carried out without tillage, it was the same, and for plowing and chisel cultivation its values were 1.22-1.24 g/cm3, which was less than in the control and the fourth option by 0.9 g/cm3, In all treatment options, soil density during the heading phase was within the optimal range and had a beneficial effect on the conditions for the growth and development of winter wheat plants.

By the time of harvesting, the soil density in all options except plowing was 1.30 g/cm3, and in the fourth option it was greater than in the control by 0.05 g/cm3, and for plowing, chiseling and disc peeling it was almost the same from 1 .28 to 1.32 g/cm3. This is due to the large amount of precipitation, which during this period exceeded long-term data.

Soil hardness is understood as its ability to prevent any object in the form of a cone or ball from penetrating into it, expressed in g/cm2.

Soil hardness is directly dependent on density and the denser the soil, the greater its hardness (Table 2). In the spring tillering phase, the lowest value of soil hardness was observed in the option with plowing and amounted to 11.6 kg/cm2, which was 4.8 kg/cm2 less than in the control; this indicator was highest in option 4, where sowing was carried out without soil treatment - 18.3 kg/cm2, which exceeded the control by 1.9 kg/cm2.

In the heading phase, the soil density in the arable layer varied from 17.6 kg/cm2 for plowing to 26.6 kg/cm2 for no-tillage. In all studied treatment options, soil hardness was within optimal values and did not have a negative effect on the growth conditions of winter wheat.

By the time of harvesting winter wheat, soil hardness had not increased significantly from the previous period of determination, and over the entire

growing season it did not have a negative impact on the growth and yield formation of winter wheat variety “Timiryazevka” 150 after soybeans.

As evidenced by the data in Table 3, the aggregate composition of the soil depended on the method of main cultivation and the phase of spring tillering.

The most agronomically valuable units were in the second and third options, according to moldboard and non-moldboard tillage at 20–22 cm. Here, the structure coefficient was 2.01–2.18, which is more than for disk plowing by 0.14 and 0. 31 respectively.

Table 2 - Change in soil hardness in winter wheat crops depending on the main treatment method

Tillage	Soil layer, cm			
	0–10	10–20	20–30	0–30
tillering in spring				
Disc peeling (k)	8.6	16.2	24.4	16.4
Plowing	7.8	11.8	14.8	11.6
Chiseling	7.9	13.7	18.0	13.2
No-till	11.6	18.6	245.7	18.3
heading				
Disc peeling (k)	19.6	24.1	29.5	24.4
Plowing	14.1	18.2	20.5	17.6
Chiseling	15.8	20.4	22.9	19.7
No-till	22.6	27.0	29.9	26.6
full ripeness				
Disc peeling (k)	20.5	26.1	32.6	26.4
Plowing	18.1	23.1	26.6	22.6
Chiseling	19.2	24.9	28.8	24.3
No-till	25.0	29.7	32.6	29.1

This indicator was lowest in option 4, where no tillage was carried out and amounted to 1.59. Before harvesting winter wheat, the number of agronomically valuable aggregates decreased in all variants, but as in the first period of determination, they were greatest in variants 2 and 3, which exceeded the control by 0.1 and 0.2, respectively.

Table 3 - Soil structure depending on the method of cultivation under winter wheat crops, 2022–2023 agricultural year. year

Tillage	Unit size, mm		Coefficient structure
	>0.25+<10	<0.25+>10	
	%	%	
tillering in spring			
Disc peeling (k)	65.1	34.9	1.87
Plowing	66.8	33.2	2.01
Chiseling	68.6	31.4	2.18
No-till	62.6	39.4	1.59
before cleaning			
Disc peeling (k)	61.8	38.2	1.62
Plowing	63.2	36.8	1.72
Chiseling	64.5	35.5	1.82
No-till	59.7	40.3	1.48

Conclusion

The lowest density and hardness of the soil was observed in the variant with moldboard plowing (control), and the highest values of these indicators were in areas with no-tillage. Disc peeling occupied an intermediate place. Main moldboard tillage provides the most optimal soil structure, better by 5.1%

compared to deep loosening without soil rotation, by 17.6% compared to shallow tillage and by 19.0% compared to zero tillage.

Bibliography

1. Archipenko, A. A. The role of mineral fertilizers and basic soil tillage for winter wheat crops in the formation of its productivity / A. A. Archipenko, R. V. Kravchenko // Scientific journal of KubSAU, 2021. – No. 171. – P. 335- 347. – DOI 10.21515/1990-4665-171-023. – EDN QZEXHZ.

2. Dmitriev, S. A. Variability of the action of mineral fertilizers against the background of basic soil cultivation in the technology of cultivating winter wheat / S. A. Dmitriev, R. V. Kravchenko, N. I. Bardak / Scientific journal of KubSAU, 2023. - No. 186. – P.31-40. – DOI 10.21515/1990-4665-186-005. – EDN MFLKAJ.

3. Kravchenko, R.V. Plant residues and soil fertility / R.V. Kravchenko, M.T. Kuprichenkov // Scientific journal of KubSAU, 2012. – No. 79. – P. 392-401. – EDN OYXGPH.

4. Kravchenko, R. V. The influence of the main soil tillage for winter wheat on the formation of elements of its productivity / R. V. Kravchenko, S. I. Luchinsky, A. A. Archipenko, A. E. Semenov // Proceedings of KubSAU, 2021. – No. 90. – P.64-70. – DOI 10.21515/1999-1703-90-64-70. – EDN WMJIJJ.

5. Kravchenko, R.V. The influence of the main soil tillage for winter wheat on the formation of its productivity / R.V. Kravchenko, V.I. Prokhoda, S.I. Luchinsky, A.A. Archipenko // Scientific journal of KubSAU, 2021. – No. 169. – P.124-132. – DOI 10.21515/1990-4665-169-011. – EDN CINXMX.

6. Kravchenko, R.V. The influence of basic tillage on the agrophysical indicators of soil under winter wheat crops / R.V. Kravchenko, S.S. Terekhova, D.S. Grechishchev / Scientific journal of KubSAU, 2022. – No. 176. – P. 96-107. – DOI 10.21515/1990-4665-176-008. – EDN TGBSML.

7. Kravchenko, R.V. Dynamics of agro-physical indicators of soil depending on its treatment and mineral fertilizers in winter wheat technology / R.V. Kravchenko, A.A. Archipenko / Scientific journal of KubSAU, 2022. - No. 178. – P. 283-292. – DOI 10.21515/1990-4665-178-024. – EDN APEXKN.

8. Kravchenko, R.V. The influence of mineral fertilizers against the background of minimizing the main tillage on the agrological indicators of winter wheat / R.V. Kravchenko, S.S. Terekhova, D.S. Grechishchev / Scientific journal of KubSAU, 2022. – No. 180. – P.193-204. – DOI 10.21515/1990-4665-180-011. – EDN FSOFIB.

9. Kravchenko, R.V. The influence of the main soil cultivation according to the predecessor sugar beet on its agrophysical indicators under winter wheat crops / R.V. Kravchenko, S.S. Terekhova, D.S. Grechishchev / Proceedings of KubSAU, 2022. - No. 96. – P.123-128. – DOI 10.21515/1999-1703-96-123-128. – EDN NNEZHF.

10. Slyusarev, VN Peculiarities of leached black soil absorption capacity in the pre-Kuban lowland in the conditions of the field agrocoenosis / VNSlyusarev, RVKravchenko, OAPodkolzin, VVKotlyarov, NNNeshchadim // International Journal on Emerging Technologies, 2020. – Vol. 11. – No. 2. – pp. 531-535. – EDN PRTYIJ.