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

РОЛЬ ПРИЕМА ОСНОВНОЙ ОБРАБОТКИ ПОЧВЫ В ФОРМИРОВАНИИ ПРОДУКТИВНОСТИ КУКУРУЗЫ

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В статье дан анализ полевых исследований по выявлению роли приема основной обработки почвы в технологии выращивания кукурузы. Выщелоченные черноземы распространены в центральной части Краснодарского края и являются основными на территории проведения опытов. Опыты проводили на кукурузе (гибрид Краснодарский 377 АМВ со сроком вегетации – 115 дней). Создан учеными Национального Центра Зерна (ранее «КНИИСХ им. П. П. Лукьяненко»). Патентообладатель Национальный Центр Зерна им. П. П. Лукьяненко. Внесен в Государственный реестр в 2011 году по Северо-Кавказскому (6) региону на зерно и силос, Нижневолжскому (8) региону на зерно. Латинское название Zea mays L. Выявлена закономерность увеличения плотности и твердости почвы при минимизации основной обработки почв в следующей последовательности: вспашка (1,12–1,25 кг/см^3 и 8,4–19,2 кг/см^2) → чизелевание (1,16–1,27 кг/см^3 и 13,5–20,9 кг/см^2) → мелкая обработка (1,20–1,32 кг/см^3 и 16,9–23,0 кг/см^2) → прямой посев культуры (1,25–1,38 кг/см^3 и 17,9–27,0 кг/см^2), соответственно. А также в течении вегетации культуры: всходы (1,12–1,25 кг/см^3 и 8,4–17,9 кг/см^2) → цветение (1,13–1,32 кг/см^3 и 14,7–24,7 кг/см^2) → полная спелость (1,25–1,38 кг/см^3 и 19,2–27,0 кг/см^2), соответственно. В период влагонакопления в почве ухудшаются процессы аккумуляции воды при минимизации основной обработки почв в следующей последовательности (по запасам продуктивной влаги) как ф вазу всходов, так и в фазу цветения: вспашка (128–102 мм) → чизелевание (118–98 мм) → мелкая обработка (105–86 мм) → прямой посев культуры (102–80 мм), соответственно. Выявлена закономерность

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4.1.1 General farming, crop production (agricultural sciences)

THE ROLE OF BASIC SOIL TILLAGE AND MINERAL FERTILIZERS IN THE FORMATION OF CORN PRODUCTIVITY

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The article provides an analysis of field research to identify the role of basic tillage in corn growing technology. Leached chernozems are common in the central part of the Krasnodar region and are the main soils in the experimental area. The experiments were carried out on corn (hybrid Krasnodar 377 AMB with a growing season of 115 days). Created by scientists of the National Grain Center (formerly KNIISH named after P. P. Lukyanenko). Patent holder National Grain Center named after. P. P. Lukyanenko. Included in the State Register in 2011 for the North Caucasus (6) region for grain and silage, and the Lower Volga (8) region for grain. Latin name Zea mays L. A pattern has been revealed of an increase in soil density and hardness with minimization of basic soil cultivation in the following sequence:plowing (1.12–1.25 kg/cm3 and 8.4–19.2 kg/cm2) → chiselling (1.16–1.27 kg/cm3 and 13.5–20.9 kg/cm2) → fine cultivation (1.20–1.32 kg/cm3 and 16.9–23.0 kg/cm2) → direct sowing of crops (1.25–1.38 kg/cm3 and 17.9–27.0 kg/ cm2), respectively. And also during the growing season of the crop: shoots (1.12–1.25 kg/cm3 and 8.4–17.9 kg/cm2) → flowering (1.13–1.32 kg/cm3 and 14.7–24 .7 kg/cm2) → full ripeness (1.25–1.38 kg/cm3 and 19.2–27.0 kg/cm2), respectively. During the period of moisture accumulation in the soil, water accumulation processes worsenwhile minimizing the main soil tillage in the following sequence (according to productive moisture reserves) both in the seedling stage and in the flowering phase:plowing (128–102 mm) → chiselling (118–98 mm) → fine cultivation (105–86 mm) → direct crop sowing (102–80 mm), respectively. A pattern has been revealed of deterioration of soil structure when minimizing its main tillage in the following sequence (according to the structure coefficient): plowing (2.12–1.29) →

ухудшения структуры почвы при минимизации основной ее обработки в следующей последовательности (по коэффициенту структурности): вспашка (2,12–1,29) → чизелевание (1,92–1,16) → мелкая обработка (1,70–1,01) → прямой посев культуры (1,51–0,81), соответственно. А также в течении вегетации культуры: всходы (2,12–1,51) → цветение (1,39–0,97) → полная спелость (1,29–0,81), соответственно

chiselling (1.92–1.16) → fine tillage (1.70–1. 01) → direct sowing of the crop (1.51–0.81), respectively. And also during the growing season of the crop: shoots (2.12–1.51) → flowering (1.39–0.97) → full ripeness (1.29–0.81), respectively

Ключевые слова: КУКУРУЗА, ГИБРИД, КРАСНОДАРСКИЙ 377 АМВ, ПЛОТНОСТЬ, ТВЕРДОСТЬ, ВЛАЖНОСТЬ, АГРЕГАТНЫЙ СОСТАВ ПОЧВЫ

Keywords: CORN, HYBRID, KRASNODARSKIY 377 AMV, DENSITY, HARDNESS, HUMIDITY, AGGREGATE COMPOSITION OF SOIL

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Introduction

The technology of growing a crop directly affects its productivity, where each element of the technology carries specific tasks aimed at solving the main problems associated with growing corn, of which 50% of the significance falls on processing soil. The variety of methods for basic soil cultivation poses certain difficulties for producers in selecting optimal agrotechnological operations. At the same time, processing soil in the summer-autumn period is the main tool in the farming system. According to many authors. with traditional moldboard tillage, corn yields can reach 7.0–9.0 t/ha. Carrying out non-moldboard loosening leads to a decrease in yield by 15% in comparison with the mouldboard background. Tillage systems also affect the weediness of grain cenoses. One of the disadvantages of chiselling is the sharp increase in weediness in the fields. [1-4]

Corn is a strategic crop of the 21st century. It has high yield potential and is widely used in production. Almost all of its parts are used in various industries that cannot do without the corn plant. Corn ranks third in demand in the world (wheat is first, rice is second). [5, 6].

Kuban has long been famous to this day for the richness and fertility of its chernozem soils, on which more than 100 types of various agricultural crops are cultivated. New economic conditions and views on soil cultivation, the

emergence of innovative resource-saving technical means and working bodies predetermine new research in improving the methods and techniques of basic soil cultivation. [7, 8]

To maintain an effective farming system, it is necessary to study the effect of each cultivation method on the soil. The main link in the soil cultivation system is the main tillage. It has a special role, since it significantly changes the co-location and structural state of soil components. In agricultural production, various methods are widely used: moldboard, non-mouldboard, rotary, combined, special. The most common traditional techniques are justified by many years of research in stationary experiments; the search for effective systems that provide an optimal balance between yield and soil fertility, costs and profits is ongoing. The choice of the optimal method of basic tillage will be determined by the agrolandscape of the crop cultivation zone, moisture availability, energy and resource intensity.[9, 10]

The relative stability of corn cultivation 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.

Material and object of research

Leached chernozems are common in the central part of the Krasnodar region and are the main soils in the experimental area. The experiments were carried out on hybrid corn Krasnodarsky 377 AMV(simple, modified, tooth-shaped, mid-season – 115 days).Created by scientists of the National Grain Center (formerly KNIISH named after P. P. Lukyanenko). Patent holder – National Grain Center named after. P. P. Lukyanenko. Authors of the variety: Chumak M.V., Chuprina M.A., Normov A.A., Zhukov M.F., Lavrenchuk N.F., Suprunov A.I., Ognyanik L.G., Zabirova E.R. , Prilipskaya N.I., Shatskaya O.A., Romanenko A.A., Kornev V.A. Included in the State Register in 2011in

the North Caucasus (6) region for grain and silage, in the Lower Volga (8) region for grain. Latin name Zea mays L.It is resistant to southern helminthosporium, it is affected very weakly by bladder smut, by cob linen - above average, by bacteriosis and fusarium of cobs it is strongly affected, and by corn stem borer it is slightly damaged.

Research methods

Experiment scheme.

FactorĀ– basic tillage methods: plowing at 25–27 cm, chiseling at 25–27 cm, disc hulling at 10–12 cm and zero tillage with direct sowing of the crop.

Factor B – fertilizer rate: no fertilizer, recommended (N80P80K80) and intensive (N120P120K120).

Methods and agricultural technology are generally accepted.

Results and its discussion

One of the indicators characterizing soil fertility is soil density. The importance of this indicator is expressed in the regulation of the water regime of the soil, since the water-carrying and water-absorbing capacity of the soil primarily depends on the state of looseness. Soil density affects many factors that determine the overall indicators of soil fertility and largely determine the vital activity of the roots of winter wheat plants. Loose soil loses more moisture and, as it settles, damages the root system. Dense soil has low water and air permeability and has an inhibitory effect on the growth of the root system of plants and, ultimately, has a great impact on the productivity of winter crops, sharply reducing it in years with a deficit of precipitation during the growing season. As our observations show, the method of basic tillage has a significant impact on its density (Table 1).

Soil density is a dynamic indicator. Its most optimal indicators were in the germination phase - from 1.12 g/cm3 in the variant with plowing to 1.25 g/cm3

in no-tillage. Chiselization and fine tillage ensured soil density at 1.16 and 1.20 g/cm3, respectively.

Table 1 - Dynamics of soil density in the 0-30 cm layer (kg/cm3)

Reception of basic soil treatment	Soil layer, cm			
	0–10	10–20	20–30	0–30
shoots				
Plowing (k)	1.08	1.14	1.18	1.12
Chiseling	1.13	1.17	1.19	1.16
Disc peeling	1.05	1.27	1.28	1.20
No-till	1.16	1.28	1.29	1.25
bloom				
Plowing (k)	1.09	1.15	1.19	1.13
Chiseling	1.14	1.18	1.20	1.17
Disc peeling	1.10	1.43	1.35	1.29
No-till	1.32	1.36	1.38	1.35
full ripeness				
Plowing (k)	1.20	1.29	1.26	1.25
Chiseling	1.22	1.32	1.27	1.27
Disc peeling	1.24	1.39	1.36	1.32
No-till	1.38	1.40	1.36	1.38

During the further growing season of corn, the density increased noticeably and in the flowering phase in the soil layer of 0–30 cm after plowing it was 1.13 g/cm3, which is more optimal than chiselling by 0.04 g/cm3, and fine tillage by 0.16 g/cm3 and soil cultivation using the no-till system by 0.22 g/cm3.

At the end of the corn growing season (before harvesting), more optimal indicators of soil density were characterized by areas where plowing was carried

out - 1.25 g/cm3, for chiseling it was 1.27 g/cm3, for disk peeling - 1.32 g/cm3 and the most dense with direct sowing of the crop - 1.38 g/cm3.

Thus, various methods of basic tillage significantly influenced the density of the arable layer in the main phases of the growing season of corn plants.

Soil hardness is directly related to density and the denser the soil, the greater its hardness. During the germination phase, the lowest value of soil hardness was noted during plowing - 8.4 kg/cm2, which is optimal than chiseling and fine tillage by 5.1 and 8.5 kg/cm2. The hardest soil was with direct sowing of the system of no-till crop - 17.9 kg/cm2, which is 9.5 kg/cm2 worse than plowing (Table 2).

Table 2 - Dynamics of soil hardness in the 0–30 cm layer (kg/cm2)

Reception of basic soil treatment	Soil layer, cm			
	0–10	10–20	20–30	0–30
shoots				
Plowing (k)	6.2	8.9	10.1	8.4
Chiseling	8.6	15.4	16.4	13.5
Disc peeling	8.8	20.7	21.3	16.9
No-till	9.4	20.7	23.7	17.9
bloom				
Plowing (k)	9.5	16.2	18.5	14.7
Chiseling	9.8	18.4	20.9	16.4
Disc peeling	9.9	22.1	27.5	19.8
No-till	21.3	25.0	27.8	24.7
full ripeness				
Plowing (k)	12.0	21.0	24.5	19.2
Chiseling	13.1	22.8	26.7	20.9
Disc peeling	14.4	24.0	30.5	23.0
No-till	23.0	27.6	30.4	27.0

In the flowering phase, the soil density in the arable layer changed from 14.7 kg/cm2 in the control (plowing) to 24.7 kg/cm2 in 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 corn.

By the time of corn harvesting, soil hardness had not increased significantly from the previous period of determination to 19.2–27.0 kg/cm2, and over the entire growing season it did not have a negative impact on the growth and formation of the corn yield.

Available moisture plays an important role, having a noticeable impact on the growth conditions, development and formation of grain yield of winter wheat. The processes of moisture accumulation were better under deep tillage and by the germination phase of corn plants, they amounted to 128 mm for plowing (control), and 118 mm for chiseling. According to disk peeling and no-tillage, moisture reserves were lower and amounted to 105 and 102 mm, respectively (Table 3).

During the flowering phase, the largest reserves in the field were in the 1st (control) variant and amounted to 102 mm, in chiseling - 98 mm.

For disk plowing and zero tillage they were lower and amounted to 86 and 80 mm, respectively.

In the phase of complete grain ripeness, there was no available moisture left in the soil where the measurements were taken - from 1 mm for plowing and chiseling, to 6 and 5 mm for disc hulling and zero tillage.

As evidenced by the data in Table 4, the aggregate composition of the soil depended on the method of main treatment.

During the germination phase, the most agronomically valuable aggregates were in the first and second options, according to moldboard and non-moldboard deep tillage at 25–27 cm.

Here the structure coefficient was 2.12 and 1.92, which is 0.32 more than for disk peeling.

Table 3 – Dynamics of productive moisture reserves in the soil, mm

Reception of basic soil treatment	Soil layer, cm					
	0–20 cm	20–40 cm	40–60 cm	60–80 cm	80–100 cm	0–100 cm
shoots						
Plowing (k)	21	22	24	29	32	128
Chiseling	20	19	22	27	31	118
Disc peeling	17	18	19	24	27	105
No-till	15	16	19	25	27	102
bloom						
Plowing (k)	17	21	23	26	15	102
Chiseling	18	23	25	19	13	98
Disc peeling	18	15	16	18	19	86
No-till	13	16	17	17	19	80
full ripeness						
Plowing (k)	-	-	-	-	1	1
Chiseling	-	-	-	1	-	1
Disc peeling	-	-	2	1	3	6
No-till	-	-	-	2	3	5

This indicator was lowest in option 4, where no tillage was carried out and amounted to 1.51.

Before harvesting corn, the number of agronomically valuable aggregates decreased in all options, but as in the first period of determination, they were greatest in options 2 and 3, which exceeded the control by 0.1 and 0.2, respectively.

Table 4 - Dynamics of soil structure in the 0-30 cm layer depending on the method of its main cultivation under corn crops

Reception of basic soil treatment	Aggregate size, %		Structurality coefficient
	>0.25+<10	<0.25+>10	
shoots			
Plowing (k)	67.9	32.1	2.12
Chiseling	65.8	34.2	1.92
Disc peeling	63.0	37.0	1.70
No-till	60.1	39.9	1.51
bloom			
Plowing (k)	58.3	41.7	1.39
Chiseling	56.2	43.8	1.28
Disc peeling	54.0	46.0	1.17
No-till	49.2	50.8	0.97
full ripeness			
Plowing (k)	56.4	41.7	1.29
Chiseling	53.8	43.8	1.16
Disc peeling	50.3	49.7	1.01
No-till	44.9	50.8	0.81

Conclusions

Thus, a pattern has been revealed of an increase in soil density and hardness while minimizing the main soil tillage in the following sequence: plowing (1.12–1.25 kg/cm3 and 8.4–19.2 kg/cm2) → chisel cultivation (1, 16–1.27 kg/cm3 and 13.5–20.9 kg/cm2) → fine cultivation (1.20–1.32 kg/cm3 and 16.9–23.0 kg/cm2) → direct sowing of the crop (1.25–1.38 kg/cm3 and 17.9–27.0 kg/cm2), respectively. And also during the growing season of the crop: shoots (1.12–1.25 kg/cm3 and 8.4–17.9 kg/cm2) → flowering (1.13–1.32

kg/cm3 and 14.7–24 .7 kg/cm2) → full ripeness (1.25–1.38 kg/cm3 and 19.2–27.0 kg/cm2), respectively. During the period of moisture accumulation in the soil, the processes of water accumulation worsen while minimizing the main soil cultivation in the following sequence (according to the reserves of productive moisture) both in the seedling phase and in the flowering phase: plowing (128–102 mm) → chiselling (118–98 mm) → fine cultivation (105–86 mm) → direct crop sowing (102–80 mm), respectively. A pattern has been revealed of deterioration of soil structure when minimizing its main tillage in the following sequence (according to the structure coefficient): plowing (2.12–1.29) → chiselling (1.92–1.16) → fine tillage (1.70–1. 01) → direct sowing of the crop (1.51–0.81), respectively. And also during the growing season of the crop: shoots (2.12–1.51) → flowering (1.39–0.97) → full ripeness (1.29–0.81), respectively.

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