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4.1.1. Общее земледелие и растениеводство (сельскохозяйственные науки)

ДИНАМИКА ФОРМИРОВАНИЯ ПРОДУКЦИОННЫХ ПОКАЗАТЕЛЕЙ КУКУРУЗЫ ПРИ РАЗЛИЧНОЙ НОРМЕ МИНЕРАЛЬНОГО УДОБРЕНИЯ И СПОСОБЕ ОБРАБОТКЕ ПОЧВЫ В УСЛОВИЯХ СТЕПНОГО АРГОЛАНДШАФТА

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В работе показан анализ динамики формирования продукционных показателей кукурузы гибрида Краснодарский 377 АМВ при различной норме минеральных удобрений и способе обработки почвы в условиях степного арголандшафта. Опыт 2-х факторный.Фактор А – основная обработка почвы (на 25–27 см): 1) глубокая отвальная обработка почвы (вспашка); 2) глубокая безотвальная обработка почвы (чизелевание).Фактор Б – норма удобрения: 1) без удобрений; 2) рекомендуемая ($N_{60}P_{60}K_{60}$); 3) интенсивная ($N_{120}P_{120}K_{120}$). Выявлено, что раньше всего цветение метелки наступило на варианте с чизелеванием без удобрений – 08.07. На 2 дня позже цветение наступило на контрольном варианте при вспашке на глубину 25–27 см без удобрений п при чизевании при применении $N_{60}P_{60}K_{60}$ – 10.07. Быстрее всего полной спелости зерна достиг вариант с дисковым лущением на глубину 8–10 см без применения удобрений. Несколько позднее вариант с чизелеванием с применением $N_{60}P_{60}K_{60}$ и вариант контроля со вспашкой на глубину 25–27 см без применения удобрений. При проведении чизелевания в основную обработку почвы у растений кукурузы период вегетации сокращался на 2 дня по сравнению с вариантами, где в основную обработку почвы проводили вспашку на 25-27 см. Внесение минеральных удобрений способствовало удлинению периода вегетации растений на 3 и 5 дней, соответственно, по рекомендуемой и интенсивной нормам удобрения на обоих фонах основной обработки почвы. Лучшие структурные показатели отмечены на варианте со вспашкой при применении минеральных удобрений по интенсивной норме

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4.1.1. General agriculture and crop production (agricultural sciences)

DYNAMICS OF FORMATION OF PRODUCTION INDICATORS OF CORN WITH VARIOUS RATE OF MINERAL FERTILIZER AND METHOD OF SOIL CULTIVATION IN STEPPE ARGONLANDSCAPE CONDITIONS

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The article presents an analysis of the dynamics of formation of production indicators of the Krasnodar 377 AMV hybrid corn with different rates of mineral fertilizers and methods of soil cultivation in the conditions of a steppe argolandscape. The experiment is two-factor. Factor A is the main soil cultivation (at 25–27 cm): 1) deep moldboard soil cultivation (plowing); 2) deep moldboard-less soil cultivation (chisel plowing). Factor B is the fertilization rate: 1) without fertilizers; 2) recommended (N60P60K60); 3) intensive (N120P120K120). It was revealed that the earliest panicle flowering occurred in the variant with chisel plowing without fertilizers – on 07/08. Flowering occurred 2 days later in the control variant with plowing to a depth of 25–27 cm without fertilizers and with chisel cultivation using N60P60K60 – 10.07. The grain reached full maturity the fastest in the variant with disk stubble cultivation to a depth of 8–10 cm without fertilizers. Somewhat later in the variant with chisel cultivation using N60P60K60 and the control variant with plowing to a depth of 25–27 cm without fertilizers. When chisel cultivation was carried out during the primary soil cultivation, the vegetation period of maize plants was reduced by 2 days compared to the variants where plowing to 25–27 cm was carried out during the primary soil cultivation. The application of mineral fertilizers contributed to the extension of the vegetation period of plants by 3 and 5 days, respectively, at the recommended and intensive fertilizer rates on both backgrounds of primary soil cultivation. The best structural indicators were noted in the variant with plowing and application of mineral fertilizers at an intensive rate (N120P120K120). The actual yield was highest with plowing to a depth of 25–27 cm using fertilizers at a

($N_{120}P_{120}K_{120}$). Фактическая урожайность больше всего была по вспашке на глубину 25– 27 см с применением удобрений в дозе $N_{120}P_{120}K_{120}$ – 74,2 ц/га. На 4,6 ц/га меньше этот показатель отмечен при такой же дозе удобрений по дисковому лущению на глубину 8–10 см – 69,6 ц/га. 66,7 и 66,1 ц/га составила урожайность при внесении минеральных удобрений в дозе $N_{60}P_{60}K_{60}$ по вспашке на глубину 25–27 м и при чизевании соответственно. Самой низкой фактическая урожайность была на варианте с чизелеванием без применения удобрений – 50,3 ц/га. На 3 ц/га выше этот показатель отмечен при вспашке на глубину 25–27 см без применения удобрений. Наибольшее превышение над контролем составил вариант со вспашкой на глубину 25–27 см с применением минеральных удобрений в дозе $N_{120}P_{120}K_{120}$ – 39,2 %, несколько ниже вариант с применением минеральных удобрений в дозе $N_{60}P_{60}K_{60}$ – 25,1 %

Ключевые слова: КУКУРУЗА, ГИБРИД, КРАСНОДАРСКИЙ 377 АМВ, СТРУКТУРА УРОЖАЯ, УРОЖАЙНОСТЬ

dose of N120P120K120 – 74.2 c/ha. This indicator was 4.6 c/ha less with the same dose of fertilizers after disk stubble cultivation to a depth of 8–10 cm – 69.6 c/ha. The yield was 66.7 and 66.1 c/ha with the application of mineral fertilizers at a dose of N60P60K60 after plowing to a depth of 25–27 m and with chiselization, respectively. The lowest actual yield was in the variant with chiselization without the use of fertilizers – 50.3 c/ha. This indicator was 3 c/ha higher when plowing to a depth of 25–27 cm without using fertilizers. The greatest excess over the control was in the variant with plowing to a depth of 25–27 cm using mineral fertilizers at a dose of N120P120K120 – 39.2%, slightly lower in the variant with the use of mineral fertilizers at a dose of N60P60K60 – 25.1%

Keywords: CORN, HYBRID, KRASNODAR 377 AMB, CROP STRUCTURE, YIELD

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Introduction

The main objective of agriculture and plant growing as its sub-sector is a steady increase in field crop yields. At the same time, grain crops, and especially corn, play a leading role as one of the most significant and widespread crops in the world. Each element of agricultural technology has specific tasks aimed at solving the main problems associated with growing a specific crop. Agricultural technologies for growing modern agricultural crops developed by our scientists have a number of advantages. These include: activation of additional energy source mechanisms in plants; stimulation of growth and development of reproductive organs; stress relief after the use of herbicides (and other pesticides); strengthening the immune status of the crop; no waiting periods, use at any stage of crop development; possibility of use in tank mixtures with chemical plant protection products; increased resistance to fungal and bacterial diseases; provision of plants with the necessary nutrients during the most critical growth phases; increased yield and improved quality. For its stable growth, in addition to agricultural technology, it is necessary to provide appropriate

adaptive or ecologically flexible varieties and hybrids, scientifically based nutrition and processing systems. New economic conditions and views on soil processing, the emergence of innovative resource-saving technical means and working bodies predetermine new research in improving the methods of primary soil processing.To increase the yield of winter wheat, along with the correct choice of varieties and means of protection, the introduction of mineral fertilizers also plays an important role. In arid zones, the presence of productive moisture in the soil plays an important role. In order to dissolve the solid fertilizers that we introduce, moisture from the upper soil layer is required, therefore, when there is a deficit of this very moisture, liquid fertilizers show themselves better. If the year turns out to be wet, then solid fertilizers are in no way inferior to liquid fertilizers [1-10].

A significant number of scientists have conducted research on the study of corn agrotechnologies. They note the need to use intensive methods of increasing the yield of corn grain with the introduction of complete mineral fertilizer at a high rate in order to optimize the conditions of root nutrition [11, 12].

Material and object of research

The most unique region in the Russian Federation is considered to be the Krasnodar Territory. This is due to its geographical location and the great diversity of landscapes, soil and climate conditions and the occurrence of surface and underground waters, as well as the great diversity of flora and fauna. Kuban has long been famous for the richness and fertility of its black soils, on which more than 100 types of various agricultural crops are grown.

The territory of the educational farm "Kuban" (the place of the experiments) is included in the Kuban delta area, represented by the Predkuban plain, and also belongs to the forest-steppe and steppe zone of the Ciscaucasian forest-steppe province. The land plot is located on the right bank of the Kuban

River, on the first floodplain terrace. According to agroclimatic parameters, the experimental area is classified as the central zone of the Krasnodar Territory. Moderate continental – this is how the climate of the experimental area can be characterized, even moderately humid. The soil cover is represented by chernozem, the leached subtype. In the territory of the laid experiment, easterly and westerly winds prevailed. Such winds as easterly and north-easterly have the property of adversely affecting the climate of the area. They have a detrimental effect on crops in winter, causing freezing, and at a speed of over 10 km / h they create dust and black storms. They also bring dry winds in the spring and summer.

Subject of research: corn. The name of the hybrid we used in the experiment is Krasnodar 377 AMV.

Research methods

Two-factor experiment.

Factor A – primary soil cultivation (25–27 cm): 1) deep moldboard tillage (plowing); 2) deep non-moldboard tillage (chisel plowing).

Factor B – fertilizer rate: 1) without fertilizers; 2) recommended (N60P60K60); 3) intensive (N120P120 K120).

Three-fold repetition with randomized placement of variants.

The methods and agricultural technology are generally accepted.

Stubble plowing after wheat was carried out using a BDN-2400 disc harrow. In the second ten-day period of December, plowing was carried out using a PO-4-35 reversible plow in combination with an MTZ-1221 tractor. Pre-sowing cultivation was carried out using a KPS-4 cultivator to a depth of 4–6 cm in combination with an MTZ-1025 tractor. Sowing was carried out using a GASPARDO seeder in combination with an MTZ-1025 tractor. After sowing, the soil was rolled using ZKKSh rollers with a first roller width of 2.2. In the 3–5 leaf phase, the Derby herbicide was applied against weeds at a dose of 70 g/ha

using an AMASONE U 901 sprayer. During the growing season, two inter-row cultivations were carried out using a KRN-4.2 cultivator in combination with a YUMZ-6 tractor. The corn was harvested using a TERRION-2010 combine.

Results and discussion

The duration of the vegetation period depends on the conditions of the vegetation phases and the varietal characteristics of the crop. In soybean plants, the vegetation period is noted from the moment of emergence until the seeds are fully ripe. During this time, the plants go through all stages of growth and development. The duration of each development phase depends significantly on the genotype of the variety, air temperature and humidity, length of daylight hours and sowing date.

The vegetation period is the time required for a plant to complete its full growth and development cycle. The influence of factors such as varietal characteristics and growing conditions determine the duration of this period. For soybeans, the following phases have been established as starting dates: germination, branching, flowering, bean formation, grain filling, and full maturity.

Our phenological observations of corn plants allowed us to identify some differences in the dates that determine the entry of plant phenophases in correlation with the method of soil cultivation and the rate of mineral fertilizers (Table 1).

After sowing corn on April 18, the date of emergence of seedlings in all variants was noted simultaneously – May 5.

The flowering phase did not occur simultaneously. The earliest flowering occurred in the variant with chisel cutting without fertilizers – July 8.

Flowering occurred 2 days later in the control variant with plowing to a depth of 25–27 cm without fertilizers and with chiselling using N60P60K60 –

July 10. Flowering was noted in the variant with chiselling using N120P120 on July 11.K120Late flowering was noted in the control variant with plowing to a depth of 25–27 cm using N60P60K60 and N120P120K120– July 12 and 13, respectively.

Table 1 – Dates of onset of the main phases of vegetation of corn plants

Option		Sowing	Shoots	Bloom	Full ripeness of grain
soil cultivation	fertilizer rate				
Plowing	b/fertilizers (k)	18.04	05.05	10.07	09.09
	N60P60K60	18.04	05.05	12.07	12.09
	N120P120K120	18.04	05.05	13.07	14.09
Chiseling	b/fertilizers	18.04	05.05	09.07	07.09
	N60P60K60	18.04	05.05	11.07	10.09
	N120P120K120	18.04	05.05	12.07	12.09

Full grain maturity was earliest noted in the variant with chiselization cm without the use of fertilizers - September 5. For other variants, the dates of onset were as follows. Thus, September 8 - chiselization with the use of N60P60K60, September 9 – plowing to a depth of 25–27 cm without the use of fertilizers, September 10 – chisel tillage using N120P120K120, September 12 – plowing to a depth of 25–27 cm using N60P60K60 and September 14 – plowing to a depth of 25–27 cm using N120P120K120.

We conclude that the variant with chisel tillage without the use of fertilizers reached full grain maturity the fastest. A little later, the variant with chisel tillage using N60P60K60 and the control variant with plowing to a depth of 25–27 cm without the use of fertilizers.

The method of soil cultivation and the use of mineral fertilizers had different effects on the biometric indicators of maize plant growth. The data are presented in Table 2. The largest number of corn plants was obtained in the

variant with plowing to a depth of 25–27 cm with the use of fertilizers at a dose of N120P120K120 – 61.2 thousand units/ha. This exceeded the variant with plowing to a depth of 25–27 cm and the use of N60P60 K60 by 0.8 thousand units/ha.

Table 2 – Biometric indicators of corn plant growth before harvesting depending on the method of primary soil cultivation and the rate of mineral fertilizer

Option		Indicator		
soil cultivation	fertilizer rate	quantity plants, thousand pcs/ha	height plants, cm	quantity cobs, pcs./plant
Plowing (control)	b/fertilizers (k)	59.6	197	0.98
	N60P60K60	60.4	239	1.00
	N120P120K120	61.2	254	1.02
Chiseling	b/fertilizers	58.5	195	0.98
	N60P60K60	59.1	233	1.00
	N120P120K120	60.1	249	1.02

In the variant with plowing to a depth of 25–27 cm without the use of fertilizers, the number of plants was 59.6 thousand units/ha.

In the variant with chisel cutting, the number of plants was slightly lower. Thus, in the variant without fertilizers, this indicator was 58.5 thousand units/ha, with the use of mineral fertilizers at a dose of N60P60 K60 - 59.1 thousand units/ha and with the use of mineral fertilizers at a dose of N120P120K120– 60.1 thousand pieces/ha.

The highest plant numbers were observed in the variant with plowing and the use of mineral fertilizers at a dose of N120P120K120.

Having studied the height of corn plants, we came to the conclusion that it was greatest in the variant with plowing to a depth of 25–27 cm with the use of

mineral fertilizers at a dose of N120P120K120In this variant, the corn plants reached a height of 254 cm. In the variant with the same dose of fertilizers and chisel cutting, the height of the corn plants was 9 cm less and amounted to 245 cm.

A slightly lower height of corn plants was noted in the variant with plowing to a depth of 25–27 cm and with disc stubble cultivation to a depth of 8–10 cm when using mineral fertilizers at a dose of N60P60 K60. Thus, with plowing this indicator was 239 cm, with disc stubble cultivation 227 cm. The lowest indicators of corn plant height were noted in the variant without the use of fertilizers both with plowing to a depth of 25–27 cm and with chisel cultivation.

The highest number of cobs per plant was in the variant with the use of fertilizers at a dose of N120P120K120when plowing to a depth of 25–27 cm – 1.02 pcs/plant. This indicator was 0.02 pcs/plant less when plowing to a depth of 25–27 cm when using N60P60K60 and when chiselling when using N120P120.K120It amounted to 1.00 pcs./plant.

The same number of cobs was observed in the variants with plowing to a depth of 25–27 cm without the use of fertilizers and with chiselling using N60P60 – 0.98 pcs/plant. The smallest number of cobs was observed in the variant with chiselling without the use of fertilizers – 0.97 pcs/plant.

We conclude that the best biometric indicators of corn plants were in the variant with plowing to a depth of 25–27 cm using N120P120K120.

The yield structure of the hybrid corn Krasnodar 377 AMV is presented in Table 3.

The highest weight of the cob with grain was noted in the variant with chisel plowing with the use of fertilizers at a dose of N60P60 K60 – 432 g. This exceeded the control variant with plowing to a depth of 25–27 cm without the use of fertilizers by 58 g. In the variant with chisel plowing without the use of fertilizers, the weight of the cob with grain was 401 g, which is 27 g more than

the control variant with plowing to a depth of 25–27 cm without the use of fertilizers.

The lowest weight of the cob with grain was in the control variant with plowing to a depth of 25–27 cm without the use of fertilizers – 374 g.

Table 3 – Structure of the grain yield of the Krasnodar 377 AMV hybrid corn depending on the method of primary soil cultivation and the rate of mineral fertilizer

Option		Length of the cob, cm	Number of grains per cob, pcs.	Weight of grain from 1 cob, G	Grain yield, %	M1000 Grains, G
soil cultivation	fertilizer rate					
Plowing	b/fertilizer (k)	20	374	93.9	85.7	251
	N60P60K60	22	384	114.8	84.4	299
	N120P120K120	22	405	125.4	84.1	310
Chiseling	b/fertilizers	21	399	108.6	84.7	272
	N80P80K80	21	403	116.5	84.1	289
	N120P120K120	23	390	116.7	84.4	299

The number of kernels in the cob varied across the variants. The highest number was observed in the variant with plowing to a depth of 25–27 cm when using mineral fertilizers at a dose of N120P120 – 595.0 g. In the variant with the same dose of fertilizers during chiselling, this figure was 588.7 g, i.e. 6.3 g less than in the variant with plowing to a depth of 25–27 cm.

The number of grains per cob was slightly lower in the variant with the use of mineral fertilizers at a dose of N60P60K60both when plowing to a depth of 25–27 cm and when stubble cultivating to a depth of 8–10 cm. When plowing, this figure was 577.0 g, and when disc stubble cultivating – 581.1 g.

The lowest indicators of the number of grains in the cob were noted in the variants without the use of fertilizers. When plowing to a depth of 25-27 cm, this indicator was 542.9 g, with chiselling it was 5.2 g less (537.7 g).

The grain weight from one cob of 125.4 g was obtained by plowing to a depth of 25–27 cm using N120P120K120. This indicator was 6.2 g less with the same dose of fertilizers for disc stubble cultivation to a depth of 8–10 cm and amounted to 119.2 g. The grain weight per cob was slightly less when using mineral fertilizers at a dose of N60P60K60 both for plowing to a depth of 25–27 cm (114.8 g) and for chiselling (116.1 g). The lowest grain weight per cob was in the variants without the use of fertilizers. After plowing to a depth of 25–27 cm, it amounted to 93.9 g, and after chiselling – 89.8 g.

The grain yield was determined as a percentage and the data were obtained. The highest grain yield was obtained with plowing to a depth of 25–27 cm without the use of fertilizers – 65.7%. This indicator was slightly lower (by 0.5%) in the variant with chisel tillage to a depth of 8–10 cm – 65.2% also without the use of fertilizers. With the use of fertilizers at a dose of N60P60K60 in the variant with plowing to a depth of 25–27 cm, the grain yield was 64.4%, in the variant with chisel tillage to a depth of 8–10 cm – 64.1%. With the use of fertilizers at a dose of N120P120K120in the variant with plowing to a depth of 25–27 cm, the grain yield was 64.1%, in the variant with chisel plowing – 0.8% more, i.e. 64.9%.

The highest grain mass was obtained in the variant with plowing to a depth of 25–27 cm using N120P120K120– 211 g. A slightly lower grain weight was also noted in the variant with chiselization and with the use of fertilizers in the dose of N120P120K120– 202 g. The next in descending order of grain weight is the option with chiselization. Thus, with a dose of mineral fertilizers N60P60 K60 this indicator was 200 g, and without the use of fertilizers – 167 g.

The lowest grain weight was obtained with disc stubble cultivation to a depth of 8–10 cm without the use of fertilizers – 167 g, and with plowing to a depth of 25–27 cm without the use of fertilizers – 173 g.

In our studies we calculated biological yield. The data are presented in Table 4.

The highest biological grain yield was obtained with the use of mineral fertilizers at a dose of N120P120K120by plowing to a depth of 25–27 cm – 765 g/m2 and by chiselling – 715 g/m2.

Table 4 – Yield of corn hybrid Krasnodar 377 AMV

Option		Productivity		Deviation, ±	
soil cultivation	fertilizer rate	biological, g/m2	factual, t/ha	t/ha	%
Plowing	b/fertilizers (k)	554	5.13	-	-
	N60P60K60	689	6.44	+13.1	+25.5
	N120P120K120	765	7.10	+19.7	+38.4
Chiseling	b/fertilizers	641	5.90	+7.7	+15.0
	N60P60K60	699	6.46	+13.3	+25.9
	N120P120K120	712	6.56	+14.3	+27.9

The biological yield was 76 g/m2 lower than with plowing in the variant with plowing to a depth of 25–27 cm when using fertilizers at a dose of N60P60K60 and amounted to 689 g/m2. The variant with the use of disc stubble cultivation to a depth of 8–10 cm and mineral fertilizers at a dose of N60P60 K60 was 4 g/m2 lower than this variant – 685 g/m2.

The lowest indicators of biological yield of corn grain were in the variants without the use of fertilizers.

Thus, when plowing to a depth of 25–27 cm, it amounted to 554 g/m2, and with disc stubble cultivation – 521 g/m2.

The actual yield was highest when plowing to a depth of 25–27 cm using fertilizers at a dose of N120P120K120– 74.2 c/ha. This indicator was 4.6 c/ha less with the same dose of fertilizers during chiselling – 69.6 c/ha. The yields were 66.7 and 66.1 c/ha when applying mineral fertilizers at a dose of N60P60 K60 by plowing to a depth of 25–27 cm and by disc stubble cultivation to a depth of 8–10 cm, respectively.

The lowest actual yield was in the variant with disk stubble cultivation to a depth of 8–10 cm without the use of fertilizers – 50.3 c/ha. This figure was 3 c/ha higher when plowing to a depth of 25–27 cm without the use of fertilizers.

The greatest excess over the control was in the variant with plowing to a depth of 25–27 cm using mineral fertilizers at a dose of N120P120K120– 39.2%, this figure was slightly lower in the variant with the use of mineral fertilizers at a dose of N60P60 K60 – 25.1%.

Conclusions

So, flowering occurs first.panicles stepped on the option with chisel cuttingwithout fertilizers – July 8. Two days later, flowering occurred in the control variant with plowing to a depth of 25–27 cm without fertilizers and with chiselling using N60P60 – July 10. The variant with disc stubble plowing to a depth of 8–10 cm without the use of fertilizers reached full grain maturity the fastest. A little later, the variant with chiselling using N60P60K60and a control variant with plowing to a depth of 25–27 cm without the use of fertilizers. When chisel tillage was carried out during the main tillage, the vegetation period of corn plants was reduced by 2 days compared to variants where plowing to 25–27 cm was carried out during the main tillage. The application of mineral fertilizers contributed to the extension of the vegetation period of plants by 3 and 5 days, respectively, at the recommended and intensive fertilizer rates on both backgrounds of the main tillage. The best structural indicators were noted in the variant with plowing when using mineral fertilizers at an intensive rate

(N120P120K120). The actual yield was highest when plowing to a depth of 25–27 cm with the use of fertilizers at a dose of N120P120K120– 74.2 c/ha. This indicator was 4.6 c/ha lower with the same dose of fertilizers for disc stubble cultivation to a depth of 8–10 cm – 69.6 c/ha. The yield was 66.7 and 66.1 c/ha when applying mineral fertilizers at a dose of N60P60 after plowing to a depth of 25–27 m and with chisel tillage, respectively. The lowest actual yield was in the variant with chisel tillage without the use of fertilizers – 50.3 c/ha. This indicator was 3 c/ha higher when plowing to a depth of 25–27 cm without the use of fertilizers. The greatest excess over the control was in the variant with plowing to a depth of 25–27 cm with the use of mineral fertilizers at a dose of N120P120.K120 – 39.2%, slightly lower is the option with the use of mineral fertilizers at a dose of N60P60K60– 25.1%.

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