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YIELD AND PHOTOSYNTHETHIC ACTIVITY OF CORN HYBRIDS WITH MINERAL FERTILIZERS AND GROWTH STIMULATORS APPLICATION

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Abstract

The article presents data of the assessment of the application effect of mineral fertilizers and growth stimulators on the photosynthetic activity of corn plants, as well as on the yields of early and middle-early hybrids of corn. Research conducted on the experimental field of the research laboratory "Korma" of the Samara State Agricultural Academy in 2015-2017. It was established that the grain yield of corn hybrids with the application of mineral fertilizers for the years 2015-2017 was 4,70 ... 7,17 t/ha., where the hybrid Gitago (FAO 200) is leading on the background 3. With the use of growth stimulators, the corn crop yield was 4,86 ... 5,86 t / ha. with the maximum index in Dolphin hybrid with application of Megamix N10. Agrophytocenosis of corn on average for 2015-2017, when applying mineral fertilizers to the phase of milky wax maturity, formed 21.27 ... 35.84 thousand m^2 / ha. leaf surface with a maximum in the TK 202 hybrid on the 3 background. The largest area of leaves in variants with the use of growth stimulants is noted on hybrids Dolphin and Krasnodarsky 194– 35.78 and 37.06 thousand m^2 / ha, with the use of Aminocate. Maximum PP were observed in TK 202 hybrids and Dolphin – 1.95 and 1.92 million m^2 / ha, on background 3. The maximum PP with stimulant application was 2.50 million m^2 / ha. The highest NPP is observed when applying mineral fertilizers on the Falcon hybrid (FAO 180) - 10.06 g/m^2 day. With the use of growth stimulators, the NPP is at the level of 6.82 ... 8.10 g/m^2 day with the highest index in the Krasnodarsky 194 hybrid.

Key words: corn, fertilizers, growth stimulators, photosynthesis, leaf area.
JEL Codes: Q1, Q16

Introduction

Corn – one of the main crops in the world agriculture. It takes an important role in development of feeding base as a plant with high productivity [3].

Corn is a second crop after rice on the agricultural market on national and international level. It is one of the most universal grain crop, which have a high level of adaptability to different environmental factors [12].

Corn has been traditionally one of the leading fodder crops. Even with a slight increase in the number of cattle and pigs in the near future, it is planned to expand the cultivated areas occupied by corn [6]. The creation of a sustainable and full-fledged food base for reviving livestock is an important task of modern crop production. The deficit and high cost of agricultural inputs in the cultivation of field crops requires a detailed adjustment of their cultivation technologies [2]. Corn is characterized by a stable response to fertilizers and intensive consumption of elements of mineral nutrition, by the way, the use of nitrogen fertilizers is a key component for sustainable corn production, which depends on a number of factors: soil-climatic conditions in the cultivation region, maturity of the hybrid and so on. [8, 11].

In modern plant growing besides the usage of mineral fertilizers, the most promising method is the use of plant growth and development stimulants. A wide range of names of regulators and stimulators of plant growth and development, permitted by the special commission of the AIC for use in the territory of the Russian Federation, often makes it difficult to choose the right one. [9].

As known, the most important process of plant life is photosynthesis. On how it proceeds, first of all depends the growth and development of plants, then their yield. [2].

The use of fertilizers is a powerful factor in the formation and activation of the photosynthetic activity [3], and the use of growth stimulants allows to save the activity of corn leaves. Therefore, these studies aimed at studying the effect of introducing increased doses of mineral fertilizers and new growth stimulants are very relevant.

In addition, an analysis of the state of forage production in the Samara Region shows that forage harvesting is still slowly stabilized while their quality is low [1]. And one of the main conditions for a stable increase in crop yield and quality is the cultivation of highly productive hybrids using technologies that take into account the bioclimatic potential of the region [10], which is also very important in the context of climate change in the Samara region.

The goal of the study is optimization of the methods of corn cultivation for grain usage in the conditions of the forest steppe of the Middle Volga region.

Research objectives: To assess the parameters of photosynthetic activity indicators of corn plants in crops. Determine the productivity of different in early maturity of corn hybrids when introducing mineral fertilizers. To assess the productivity of early maturing corn hybrids when using growth stimulants.

Proceedings
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Materials and methods

The research was conducted in 2015-2017 on the experimental field of the research laboratory "Korma" of the plant breeding and agriculture department.

The soil of the experimental site is chernozem, the ordinary residual-carbonate medium-humus medium-heavy heavy loam with easily digestible nitrogen content of 127 mg, mobile phosphorus 130 mg and exchange potassium 311 mg per kg soil, pH 5.8. Humidification is natural. Agrotechnics are common and typical for the current zone.

The calculated fertilizer rates were introduced in a scattered manner for basic soil cultivation - plowing to a depth of 25-27 cm in the form of a diammophos and ammonium nitrate. Depending on the content of mobile forms of NPK, obtained from the results of soil diagnostics, the fertilizer rates for experiments over the years were different. On the background 1, for a planned yield of 7 tons / ha, applied a diammophos 96-102 kg/ha, an ammonium nitrate of 100-117 kg/ha. On background 2 for a planned yield of 8 tons / ha, 120-147 kg/ha and 110-138 kg/ha. On background 3 for the planned yield of 9 t / ha 140-195 and 120-156 kg / ha, respectively

The sowing was performed on a depth of 5-6 cm by the seed drill UPS-8 in a wide-band method. The seeding rate was 65 thousand germinated seeds per hectare. Growth stimulants Aminokat and Megamix N10 were applied at the phase of 5-6 leaves at a dose of 0.5 l/ha. Yield calculations were carried out by the harvesting 10 m^2 plots in a four repetitions with complete analysis of the crop structure. The mass and share of the full maturity of the ears, the mass and fraction of the grain, the moisture content of the grain were determined, the yield was brought to a moisture content of 14%.

Scheme of experiment 1 of the study of the effect of mineral fertilizers on various hybrids with different maturity was following: three backgrounds of mineral fertilizer (factor A): application of NPK to the planned yield of 7 t/ha, 8 t/ha, 9 t/ha; hybrids: early maturity - Falcon, Dolphin, Krasnodar 194; midearly - Gitago, TK 202, Eurostar (Factor B). The grouping of hybrids by FAO was carried out by their maturity, declared by the originators of these hybrids. Total options in the experiment 18. Plots 72. The plot area is 93.52 m^2. The total area under the experience is 0.7 ha.

Scheme of experiment 2 of the study of the effect of growth stimulants on early maturing corn hybrids was as follows: preparations: Aminokat, Megamix N10 (factor A); hybrids: Falcon, Dolphin, Krasnodar 194 (factor B). Total options in the experiment 9. plots 36. The plot area is 93.52 m^2. The total area under the experiment is 0.3 hectares.

Results

Weather conditions during the vegetation of corn in 2015-2017 were very different and were unfavorable, that's why was affected the productivity of corn. So, 2015 turned out to be very unfavorable for cereals, however, sue to the morphological and biological characteristics of corn, it was able to show its potential. Weather conditions in 2016 were unsuccessful for corn. The severe drought that lasted from late spring to mid-summer affected the yield of corn significantly. Particularly affected by drought during flowering time, because an increase in temperature during this period up to + 30° leads to a decrease in the viability of pollen and the susceptibility of stigmas of pistils.

Weather conditions in 2017 also proved to be very unfavorable for cultivating corn, which in the future will affect crop yields. Lack of moisture at the beginning of milk ripeness may have caused the grain to stop pouring, forming a fine grain in the upper part of the cob, which further reduces the yield.

Studies conducted in 2015-2017 revealed positive influence of mineral fertilizers and growth stimulators on growth, development, photosynthetic indices, and productivity of corn plant. It was also found that hybrids from different ripening groups respond differently to the introduction of mineral fertilizers and growth stimulants.

The main indicators that determine the productivity of plant photosynthesis are the total leaf area and the intensity of photosynthetic processes per leaf area unit[2].

In average, over three years of research, the area of corn leaves in the period of appearance of the 7th leaf was 13.76-20.93 thousand m^2 / ha, with a maximum in the early Falcon hybrid on the first background, among midearly hybrids, we note the Eurostar hybrid - the area of the leaves was 19.72 thousand m^2/ha on the second background of mineral nutrition, whereas on the first background the area of the leaves was 16.10 thousand m^2/ha The midearly hybrid TC 202 and the early Krasnodar 194 formed the maximum leaf area on the third background of mineral nutrition - 16.70 and 16.80 thousand m^2/ha, respectively. In this period of development of corn plants, a clear dependence of the influence of the studied factors on the corn leaf area has not yet been observed, since overall, all hybrids are on the same level. Probably, in the initial stages of growth and development, energy and nutrients were spent on the formation of a powerful root system.

In the next phases of development, the formation of the leaf surface is more intense. In the silking phase, the maximum leaf area is recorded in the midearly hybrid Eurostar on the first background - 37.79 thousand m^2/ha.

Proceedings
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Hybrid Gitago on the second background formed 32.14 thousand m^2/ha of leaf surface, and the hybrid of TK 35.86 thousand m^2/ha.

The area of corn leaves at the phase of filaments of the cob has made 21.34 ... 33.63 thousand m^2/ha, almost all hybrids formed the maximum area of the leaf surface at the third level of mineral nutrition. By this period the panicles have already developed and fertilization is taking place, the grain is being formed, the graininess of the ear is determined, which subsequently reflects on crop yield. Therefore, the formation of an optimal working area of the leaf surface in this period is very important.

Table 1. The area of corn leaves, depending on the application of mineral fertilizers, 2015-2017, thousand m^2/ha

Planned level of mineral nutrition	Hybrids		Average			
	FAO	Hybrids	7 leaf stage	tasseling stage	silking stage	milk maturity
Planned yield 7 t/ha (Background 1)	180	Falkone	20.93	31.47	21.34	21.27
		Dolphin	20.13	32.62	33.63	26.73
		Krasnodarsky 194	15.63	27.75	28.41	26.18
	200	Gitago	15.88	27.81	25.13	25.10
		TK 202	14.18	35.31	25.50	22.88
		Eurostar	16.10	37.79	25.33	22.90
Planned yield 8 t/ha (Background 2)	180	Falkone	20.24	29.77	24.44	23.07
		Dolphin	18.72	28.65	27.91	31.70
		Krasnodarsky 194	13.76	29.01	26.73	31.34
	200	Gitago	16.52	32.14	23.85	27.12
		TK 202	16.17	35.86	29.89	28.54
		Eurostar	19.72	29.44	29.97	26.40
Planned yield 9 t/ha (Background 3)	180	Falkone	18.07	30.56	28.95	24.12
		Dolphin	18.26	33.37	30.15	30.28
		Krasnodarsky 194	16.80	25.24	28.62	27.36
	200	Gitago	14.86	31.99	28.79	23.24
		TK 202	16.70	31.97	31.45	35.84
		Eurostar	14.79	32.99	26.34	25.98

To the phase of milky wax ripeness, the area of the leaves gradually begins to decrease, since intensive filling and ripening of the grain takes place. The largest leaf area is noted in the group of midearly hybrids: in the TK-202 hybrid on the third background of mineral nutrition – 35.84. thousand m^2/ha. Among the early-maturing hybrids, the largest area in the Dolphin is 31.70 thousand m^2/ha on the second background and in the Krasnodarskiy hybrid 194-31.34 m^2/ha also on the second background of mineral nutrition (Table 1).

It should be noted that there is a positive effect from the use of increased doses of mineral fertilizers, which further positively affects the yield of grain.

Table 2 presents the average data on the area of the corn leaf surface when using growth stimulants on average for 2015-2017, which also indicate the effectiveness of growth stimulants. Thus, the maximum area of the leaf surface is noted in the Krasnodarsky 194 and Dolphin hybrids when applying Aminokat – 37.06 thousand m^2/ha and 35.78 thousand m^2/ha respectively. Also, Krasnodarsky 194 and Dolphin hybrid when using Megamix N10 – 34.20 and 32.63 thousand m^2/ha, respectively (Table 2).

Table 2. Area of corn leaves, depending on the use of growth stimulants, 2015-2017, thousand m^2/ha

Stimulants	Hybrids	Average			
		7 leaf stage	Tasseling stage	Silking stage	Milk maturity
ck (control)	Falkone	22.05	29.65	26.23	23.66
	Dolphin	17.96	25.10	27.15	23.40
	Krasnodarsky 194	14.62	22.80	31.38	23.35
Aminocat	Falkone	20.38	25.21	32.81	29.37
	Dolphin	19.63	34.14	35.78	26.04
	Krasnodarsky 194	15.33	37.06	25.76	29.51
Megamix N10	Falkone	17.21	29.80	30.66	30.40
	Dolphin	20.73	28.73	32.63	26.97
	Krasnodarsky 194	13.08	34.20	28.93	25.17

Proceedings
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Note that in the variants using a growth stimulant on corn with mineral fertilizers on the planned yield 7 t/ha leaf surface area to the phase milky waxy corn plant is higher than variants without the use of stimulants. This suggests that the leaves retain their viability much longer, until the end of the milk-wax ripeness phase. This allows the plants to form a full grain yield, in spite of the weather conditions and the lack of soil moisture during the critical periods of life.

Important indicators that characterize the photosynthetic activity of crops are the photosynthetic potential (PP) and the net productivity of photosynthesis (NPP). Our researches revealed that the value of PP and NPP depends on the factors studied (application of mineral fertilizers, application of growth stimulators and selection of a hybrid), as well as weather conditions that occur during the growing season of corn.

In average, over three years of research in the early maturity hybrids, the largest photosynthetic potential is observed in the Krasnodarsky 194 hybrid on the third background of mineral nutrition - 1.92 million m ^{2} / ha, while this figure was only 1.68 million m^2 / ha on the first background and 1.69 million m ^{2} / ha days on the second background of mineral nutrition. In the midearly block of hybrids, the maximum value of the photosynthetic potential of the TK-202 hybrid on the third background of fertilizer application was 1.95 million m ^{2} / ha, while the first and second backgrounds were 1.73 and 1.72 million m^2 / ha days, respectively (Table 3).

Table 3. Photosynthetic potential, million m^2/ha days and net productivity of photosynthesis, g/m^2 day, depending on the application of fertilizers, average, 2015-2017, t/ha

Planned level of mineral nutrition	FAO	Hybrids	PP, ∑, Average, 2015-2017	NPP, average 2015-2017
Planned yield 7 t /ha (Background 1)	180	Falkone	1.71	9.19
		Dolphin	1.88	8.20
		Krasnodarsky 194	1.68	7.32
	200	Gitago	1.64	9.21
		TK 202	1.73	8.44
		Eurostar	1.82	7.81
Planned yield 8 t /ha (Background 2)	180	Falkone	1.75	8.39
		Dolphin	1.83	8.77
		Krasnodarsky 194	1.69	8.59
	200	Gitago	1.72	9.41
		TK 202	1.92	7.11
		Eurostar	1.85	8.93
Planned yield 9 t /ha (Background 3)	180	Falkone	1.80	10.06
		Dolphin	1.92	7.38
		Krasnodarsky 194	1.70	7.49
	200	Gitago	1.73	8.25
		TK 202	1.95	8.95
		Eurostar	1.71	8.64

However, if we consider by years, the maximum amount of PP reached in 2016 and amounted to 2.31 mln.m^2/ha days for the mid-term TK 202 hybrid on the second background of mineral nutrition and 2.26 mln.m^2/ha for the early Krasnodar hybrid 194 on the third background, which can be explained by more positive weather conditions in July 2016: the air temperature was practically at the level of the average summer and there was a sufficient amount of precipitation. However, the August drought did not allow corn plants to form a full yield.

It is known that the yield depends not only on the size of the leaf apparatus, but also on the productive work of the leaves, which is estimated by the indicator "net productivity of photosynthesis" (NPP).

It should be noted that as the area of leaves, PP, and FPP increases with increasing levels of mineral nutrition. Comparing three years, we can say that the Falcon hybrid leaves are more productive, which is indicated by the high rates of net productivity of photosynthesis. On average, this hybrid on the third background, for three years, the NPP was 10.06 g/m^2 day. The midearly hybrid of Gitago for three years of research showed the highest productivity of photosynthesis on the second background of mineral nutrition. On average, it was 9.41 g/m^2 day (Table 3). These indicators further allow the formation of highly productive agrophytocenosis of corn crops.

Table 4 shows the photosynthetic potential and net productivity, depending on the use of growth stimulants. On average, for 2015-2017 years, we can say that the photosynthetic potential was at the level of 1.95 ... 2.50 mln.m^2/ha, with the maximum values for the application of Aminokat and Megamix N10 on the Dolphin hybrid – 2.50 mln.m^2/ha and 2.36 million m^2/ha, respectively.

It was revealed that this indicator on variants only with the introduction of mineral fertilizers without the use of growth stimulants is much lower than on variants with the use of stimulants. Probably, the content of macro and microelements in these stimulants help plants form a more active photosynthetic apparatus and allow prolonging the vital activity of chlorophyll in cells.

Proceedings
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On average, over three years the NPP was at the level of 6.09 ... 8.10 g/m^2 day. The maximum values for the Krasnodarskiy 194 hybrid when using Aminocate are 8.10 g/m^2 day, in the Falcon hybrid – 7.46 g/m^2 day, also with the use of the Aminocate stimulant. The drug Megamix N10 showed itself well in the Falcon hybrid - the net productivity of photosynthesis was 7.40 g/m^2 day. It was revealed that the largest indicators of net productivity of photosynthesis are noted in the phase of tasseling-flowering, this indicates the effective work of the leaves, which in the future will be reflected in the formation of the future crop.

Table 4. Photosynthetic potential, million m^2/ha days and net productivity of photosynthesis, g/m^2 day depending on growth stimulators, average, 2015-2017, t/ha

Stimulants	Hybrids	PP, ∑, Average, 2015-2017	NPP, average 2015-2017
Check (control)	Falkone	2.24	6.58
	Dolphin	1.98	6.09
	Krasnodarsky 194	1.95	6.07
Aminocat	Falkone	2.30	7.46
	Dolphin	2.50	7.00
	Krasnodarsky 194	2.25	8.10
Megamix N10	Falkone	2.12	7.40
	Dolphin	2.36	6.84
	Krasnodarsky 194	2.11	6.82

The positive effect of mineral fertilizers and growth stimulants on corn productivity is clearly traced.

The yield of corn grain in 2015 on the background of mineral fertilizers was 6.44-7.94 t/ha. When applying fertilizers on the second and third background of mineral nutrition, the additional value was 0.73-1.5 t/ha in average. Among the early hybrids, the Krasnodarsky hybrid 194 showed high productivity, its yield was 7.33 t/ha when applying mineral fertilizers on the third background. The most yielding among the midearly hybrids was TK 202 (8.74 t/ha) with the application of mineral fertilizers on the third background (Table 5).

Table 5. Harvest of corn grain depending on the application of fertilizers, 2015-2017, tons/hectare

Planned level of mineral nutrition	Hybrids		2015	2016	2017	Average, 2015-2017, t / ha
	FAO	Hybrids				
Planned yield 7 t /ha (Background 1)	180	Falkone	7.14	4.40	5.37	5.64
		Dolphin	6.48	4.09	5.43	5.33
		Krasnodarsky 194	5.53	4.52	4.05	4.70
	200	Gitago	6.79	4.41	6.48	5.89
		TK 202	6.67	3.47	4.62	4.92
		Eurostar	6.05	3.59	5.31	4.98
Planned yield 8 t /ha (Background 2)	180	Falkone	7.38	4.96	6.12	6.15
		Dolphin	6.81	5.05	7.10	6.32
		Krasnodarsky 194	7.16	4.77	4.49	5.47
	200	Gitago	7.77	5.07	5.46	6.10
		TK 202	6.84	3.97	4.89	5.23
		Eurostar	7.05	4.12	5.16	5.44
Planned yield 9 t /ha (Background 3)	180	Falkone	7.47	4.80	6.82	6.36
		Dolphin	7.19	5.22	6.16	6.19
		Krasnodarsky 194	7.33	5.85	5.92	6.37
	200	Gitago	8.64	4.36	8.50	7.17
		TK 202	8.74	3.72	6.10	6.19
		Eurostar	8.26	4.38	6.73	6.46
		LSD_{05}total	0.46	0.40	0.20	
		LSD A	0.27	0.23	0.11	
		LSD B	0.19	0.16	0.08	

In 2016, the corn grain yield was 3.47 ... 5.85 t/ha, which is much less than the previous year. On average, according to FAO, the harvest was 4.08 ... 4.72 t/ha. Note that among the early-maturing hybrids the greatest yield of grain was shown by the Krasnodarsky 194 hybrid on the third background of mineral nutrition – 5.85 t/ha. From the midearly hybrids, the most yielding was the hybrid Gitago – 5.07 t / ha second background. It is known that in more humid years, the effect of mineral fertilizers increases due to a more active absorption of nutrients by plant roots. However, dry months and dry winds in 2016 prevented the formation of a full potential yield of

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corn, only the early hybrid Krasnodarsky 194, in view of its individual characteristics, was close to implementing the program.

In 2017, the maximum yield of corn grain was obtained on the third background of mineral nutrition, on the midearly hybrid Gitago – 8.50 t / ha. In the early block, the Dolphin hybrid is leading – 7.10 t/ha. Also, a stable yield was obtained in the early hybrid Falcon on the second and third background, 6.12-6.82 t/ha, respectively.

On average, for 2015-2017 years, the yield of corn grain was 4.70 ... 7.17 t/ha. In this case, the most productive was the midearly hybrid Gitago – 7.17 t/ha on the third background. In the block of early-maturing hybrids, the Falcon and Krasnodar 194 hybrids are leading with a grain yield of 6.36 and 6.37 tons/ha on the third background of mineral nutrition, respectively (Table 5).

Table 6 provides data on the effect of growth stimulants on corn grain yield.

Micro and macro elements, as well as minerals and organic substances that are part of the growth stimulants improve the balance of mineral nutrition of plants, significantly increase the habit and leaf area of plants, the size of the crop, improve the quality of products, increase the efficiency of fat, the resistance of plants to diseases that are lowered by high temperatures, drought [7].The early-hybrids studied by us reacted differently to the use of growth stimulants.

Table 6. Harvest of corn grain depending on the use of growth stimulants, 2015-2017, t/ha

Stimulants	Hybrids	2015	2016	2017	Average, 2015-2017
Check (control)	Falkone	6.39	4.12	4.56	5.02
	Dolphin	6.61	4.28	4.97	5.29
	Krasnodarsky 194	6.51	4.41	4.25	5.06
Aminocat	Falkone	5.32	4.30	4.96	4.86
	Dolphin	6.23	4.45	5.33	5.34
	Krasnodarsky 194	7.19	5.96	4.19	5.78
Megamix N10	Falkone	5.83	4.98	5.69	5.50
	Dolphin	7.64	4.46	5.49	5.86
	Krasnodarsky 194	6.79	5.47	5.09	5.78
	LSD_{05}total	0.62	0.40	0.24	
	LSD A	0.36	0.23	0.14	
	LSD B	0.36	0.23	0.14	

In 2015, Falcon's hybrid proved to be the best, its yield was 6.39 t/ha. In the variants using growth stimulators, the Krasnodarsky 194 hybrid performed well, its yield was 7.19 t/ha (using Aminokat) and the Dolphin hybrid - the yield was 7.64 t/ha with the use of Megamix N10.

In 2016, the grain yield was slightly lower than in 2015. Thus, on average, according to the options, the grain yield was 4.27-4.97 t/ha. The maximum yields were obtained by using hybrids with the use of the Megamix N10 growth promoter, in particular the Krasnodar 1944 hybrid - 5.47 t/ha, the Falcon Hybrid – 4.98 t/ha, the Dolphin hybrid – 4.46 t/ha.

In 2017, the corn grain yield was 4.19 ... 5.69 t/ha. On control, the best was the Dolphin hybrid - it formed 4.97 t/ha of grain yield. Using the Aminocat growth stimulator. we obtained the maximum yield on the Dolphin hybrid – 5.33 t/ha, which is 0.36 t/ha higher than in the control. With the use of the Megamix N10 stimulator, the largest corn grain yield is recorded on the Falcon hybrid – 5.69 t/ha (above the control variant by 1.13 t/ha).

For three years of research, the yield of grain was in the range 4.86 ... 5.86 t/ha, where the greatest yield of grain was obtained from the Dolphin hybrid – 5.86 t/ha with the use of Megamix N10. Hybrid Krasnodarsky 194 responded well to the use of stimulants: the grain yield was 5.78 t/ha as with the application of Aminokat, and when using Megamix N10 (Table 6).

Conclusions

The area of corn leaves grows up to the phase of silking, then its growth stops and by the time of milky wax maturity it decreases.

Optimum leaf area by this time is preserved in the midearly hybrid TK 202 - 35.84 thousand m^2/ha and in the early hybrids of the Dolphin - 31.79 thousand m^2/ha and Krasnodarsky 194-31.34 thousand m^2/ha.

The use of growth stimulants contributes to the growth of the corn leaves.

The apllication of mineral fertilizers increases the photosynthetic potential in the early maturing hybrids up to 1.92 million m^2/ha, the average hybrids - up to 1.95 million m^2/ha.

With the use of growth stimulators, the photosynthetic potential increases to 2.36 ... 2.50 million m^2/ha.

The grain yield of early hybrids with the application of fertilizers is higher. The Gitago hybrid provides a yield of 7.17 t/ha dry grain, the early hybrid Krasnodar 194-6.37 t/ha.

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