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Production Process And Economic Justification For The Cultivation Of Corn Hybrids.

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ABSTRACT

In terms of conducting intensive dairy cattle breeding in Russia, including in the Udmurt Republic, the organization of a stable forage base is an urgent task of agricultural production. The production of green mass of corn is one of the key solutions for the provision of agricultural animals with bulky feed during the winter-resistant period. In this regard, research on the effect of the photosynthetic activity of crops on the fodder productivity of corn is an important task. Studies on the effect of photosynthesis on the productivity and efficiency of the production of fodder mass of corn hybrids were carried out at Uchkhov July IzhGSHA on sod-medium-podzolic medium loamy soil with medium and elevated (2.3-2.8%) humus content, from strongly acid to neutral exchange acidity (pH 4.5-6.1), with a high and very high content of mobile phosphorus (190.5-274 mg / kg) and with an elevated and very high (146.3-306.2 mg / kg) of mobile potassium. Long-term studies (2013-2016) revealed that corn hybrids formed the largest leaf surface area during the flowering period - milky and waxy ripeness of grain. The collection of dry matter of corn hybrids had a direct average correlation with the leaf surface area in the phase of 7-8 leaves ($r = 0.64$), and a direct strong connection in the sweeping phase of the panicle ($r = 0.75$). On average, over four years of research, the Bemo 182 SV hybrids, Korifey and Silvinio provided the maximum dry matter collection of 13.0–16.8 t / ha with the lowest cost of 488–556 rubles per 1 ton of dry matter.

Keywords: photosynthesis, dry matter collection, economic efficiency.

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INTRODUCTION

Russia is one of the largest producers and exporters of agricultural products. The main branches of agriculture in our country are the production of grain crops, potatoes, vegetables, milk, the feeding of cattle, pigs, poultry farming, and others. One of the main problems of agricultural production in Russia is to increase the economic efficiency of the food supply [16]. The current socio-economic situation in the countryside and the level of agricultural development require new knowledge in the field of management and decision-making. Information on the productivity and economic efficiency of the cultivation of corn hybrids is one of such knowledge [13, 17].

The variability of numerical traits in growing conditions and the contact of the “genotype-environment” is inherent in the cultivation of any crops.

The emergence of this reason in breeding is that the driving forms dominate regulatory, which increase responsiveness to stabilizing factors and decline in resistance to uncontrollable environmental factors and, as a result, the presence of a specific response of genotypes to the environment, which is reflected in the environmental sustainability of crop production [6]. Academician A.A. Zhuchenko [4] characterized the complex study of this issue as follows: ... as the potential productivity of crops grows due to breeding and agrotechnology, the problem of the resistance of new varieties and hybrids to the action of abiotic and biotic stresses becomes more acute.

The issues of regulating photosynthetic activity and increasing the productivity of maize plants are a major problem. A versatile and in-depth study of the ways to control the photosynthetic activity of corn crops is based on the knowledge of this problem depending on the soil and climatic conditions of its growing areas, the biological characteristics of cultivated hybrids and the technology of plant cultivation. According to M.R. Carlone, W.A. Russel [14], theoretically calculated potential productivity of corn hybrids with upright leaves and good photosynthesis efficiency, under the conditions of Illinois with a high level of agricultural technology, can reach 3.1 centner / ha.

The potential of modern hybrids confirms the results of research in different agro-climatic zones of France (thirty-three hybrids of corn of different precocity at different densities, included in the national catalog over the past 30 years) [15].

The high productivity of corn is due to the physiology of photosynthesis, a large area of leaves, as well as a high density of the conducting network in them. Corn belongs to a small group of crops that assimilate carbon dioxide in the process of photosynthesis according to the energy-efficient scheme C_4 [10]. This gives a number of significant advantages in the formation of a corn crop. According to B.I.Gulyaev [2], corn is characterized by an increased biomass increase of 50 ... 54 g / m^2 per day, while the increase in C_3 group plants is on average 34 ... 39 g / m^2 .

Corn also surpasses other crops in the amount of chlorophyll, since this plant has a high coefficient of absorption of solar radiation energy. I.S. Shatilov and A.G. Zamoraev [9] experimentally proved that under conditions of the Moscow region (southern part) during the period of full formation of the leaf surface of corn, the utilization rate of photo synthetically active radiation (PAR) reaches 2.76 ... 5.49%. According to the experiment, with an increase in the number of plants from 40 to 222 thousand per 1 hectare, the use of solar energy for the formation of the economically useful part of the crop increases by 4–4.5 times.

Due to the fact that corn hybrids have different adaptive capacity [5,11, 12], studies of the formation of corn hybrids productivity in the conditions of the Udmurt Republic are relevant. The selection of promising corn hybrids with high adaptive potential, ensuring high yields and product quality is of practical importance.

The aim of the work is to study the effect of photosynthetic activity on the formation of the productivity of modern hybrids in the conditions of the Udmurt Republic.

The studies were carried out according to the generally accepted methodology [3] in Uchkhov July IzhGSHA(2013-2016) on sod-medium-podzolic medium loamy soil with medium and elevated (2.3-2.8%) humus content, from strongly acid to neutral exchange acidity (pH 4.5-6.1), with a high and very high content

of mobile phosphorus (190.5-274 mg / kg) and with an elevated and very high (146.3-306.2 mg / kg) of mobile potassium. The granulometric composition of the soil and the availability of nutrients determined the predicted yield.

The experimental scheme included corn hybrids of breeding KWS (Germany), FSBI VNIIC (Pyatigorsk), FSBI VNIIC (Voronezh), FSBI Krasnodar Research Institute of Agricultural Sciences named after P.P. Lukyanenko (Krasnodar), an early and middle early maturity group (Table 1).

Table 1: Corn hybrids of different selections

No	Hybrid	PAR	Maturity Group	Originator
1	Kaskad 195 SV st	190	Early maturing	Russia
2	Almaz	180	Early maturing	KWS, Germany
3	Amatus	180	Early maturing	KWS, Germany
4	Bemo 182 SV	190	Early maturing	Russia
5	Klifton	175	Early maturing	KWS, Germany
6	Korifey	170	Early maturing	KWS, Germany
7	Oferta	200	Early maturing	KWS, Germany
8	Ronaldinio	210	Mediu mearly	KWS, Germany
9	ROSS 199 MV	190	Early maturing	Russia
10	Silvinio	220	mediumearly	KWS, Germany

Experience single-factor field, repeated three times. Placement options are randomized. Accounting area plots 42 m². Hybrid Kaskad 195 SV included in the State Register of breeding achievements and approved for use in the Volga-Vyatka region is taken as the standard.

RESULTS

Research has revealed that the meteorological conditions of the growing season have a significant effect on the growth of the leaf area of a single plant. Thus, the smallest growth was in the cold and wet 2016, and the largest leaf area of one plant was in the hot and moderately wet 2014 (table 2).

Table 2: Dynamics of the area of leaves of plants of corn hybrids, thousand m² / ha

No	Hybrid	7-8 leaves phase	Sweep phase	Flowering phase	Phase of milky wax ripeness of grain
1	Kaskad 195 SV st	6,2	12,2	15,7	16,9
2	Almaz	6,9	11,8	14,8	16,3
3	Amatus	6,8	11,7	14,8	15,1
4	Bemo 182 SV	6,4	11,8	15,3	16,2
5	Klifton	7,1	11,4	15,5	16,3
6	Korifey	7,8	16,1	21,2	23,9
7	Oferta	7,1	11,6	15,7	16,7
8	Ronaldinio	7,1	11,8	15,5	16,3
9	ROSS 199 MV	5,6	10,3	13,7	14,2
10	Silvinio	6,9	12,9	16,7	18,1
Correlation coefficient with dry matter yield (r)		0,64*	0,75*	0,36	0,15

Note: * - significant at 5% significance level

This is due to the fact that a higher temperature and good moisture supply of plants at the initial stages of organogenesis (1-3 stages according to F.M. Kuperman), [7] contributed to the formation of larger leaves in 2014 in the future. According to N.I. Volodarsky [1], a stable assimilation surface serving the emerging parts of the plant, is created within 5–7 days after the emergence of corn. S.A. Semina [8], notes that

increasing the density of standing worsens the light, food and water regimes of plants, and, accordingly, reduces the leaf area of a single plant, which we found in 2013.

On average for 2013-2016 years of research, the maximum assimilation surface of corn hybrids formed during the flowering period - milky-wax ripeness of grain. The collection of dry matter of corn hybrids had a direct average correlation with the leaf surface area in the phase of 7-8 leaves ($r = 0.64$), and a direct strong correlation in the sweeping phase of the panicle ($r = 0.75$) with a confidence interval of $n = 40$ and student's criteria $t_r = 2,13$.

Among the studied hybrids, Korifey and Silvinio had the largest leaf area during the growing season, its maximum value was 18.1–23.9 thousand m^2 / ha in the phase of milky-wax ripeness of grain (table 3).

Table 3: Photosynthetic activity of corn crops

No	Hybrid	Photosynthetic potential, thousand $m^2 \times days / ha$				Net photosynthesis productivity, $g / m^2 \times day$
		2013	2014	2015	2016	
1	Kaskad 195 SV st	1043	1119	966	675	5,94
2	Almaz	909	1778	949	750	5,64
3	Amatus	1018	1848	929	726	5,13
4	Bemo 182 SV	1054	1753	948	1010	5,24
5	Klifton	1069	1800	968	788	5,06
6	Korifey	1056	1935	1297	1203	5,11
7	Oferta	1069	1791	978	737	5,44
8	Ronaldinio	1076	1616	974	673	5,31
9	ROSS 199 MV	975	1891	835	736	5,25
10	Silvinio	1080	1815	1039	908	5,03
Average		1035	1735	988	821	5,32

The value of the total photosynthetic potential of crops was in the same dependence on weather conditions and experience options as the area of leaves of sowing, since the end of the growing season of corn (harvest) falls on all options for the same period. On average, by experience, a more powerful photosynthetic potential of 1,735 thousand $m^2 \times day / ha$ of corn sowing formed in 2014, and less powerful in wet and cooler 2016 (821 thousand $m^2 \times day / ha$), or lower by 53%. For three years (2014, 2015, 2016) of four years of research, the Korifey hybrid was characterized by the formation of the greatest photosynthetic potential of 1203–1935 thousand $m^2 \times days / ha$, which is 331-816 thousand $m^2 \times days / ha$, or 34 -78% more than in the control version. In the unfavorable meteorological conditions of the growing season of 2016, the hybrid of domestic breeding Bemo 182 SV was distinguished by a relatively high photosynthetic potential of crops and was second only to the Korifey hybrid. Its photosynthetic potential, equal to 1010 thousand $m^2 \times d. / Ha$, was greater than that of other hybrids by 102–337 thousand $m^2 \times d / ha$, or by 11-50%.

On average, over four years of research, the net productivity of photosynthesis in hybrids was practically at the same level of 5.06-5.94 $g / m^2 \times day$.

Thus, the correlation analysis showed that the collection of dry matter of corn hybrids had a direct average and strong correlation with the leaf surface area during the period of intensive plant growth ($r = 0.64 \dots 0.75$), and the average correlation with the photosynthetic potential of crops during the vegetation period ($r = 0.39$).

The best conditions for the formation of corn yield were formed in 2013, as evidenced by the environmental conditions index $I_j = 6.1$, at which on average hybrids formed 18.4 t / ha of dry matter. In 2014, abiotic conditions were less favorable ($I_j = 1.9$), the productivity of hybrids was lower by 23% (14.2 t / ha). On average, the lowest dry matter yield of 5.3 t / ha corn hybrids formed in the unfavorable year 2016 with a

dangerous agrometeorological phenomenon - atmospheric drought during the period of intensive growth and excessive moisture during ripening ($I_j = -7.0$).

In 2013, the reaction to the abiotic conditions of the Almaz, Amatus, Silvinio, Korifey, Klifton, Bemo 182 SV hybrids expressed a significant increase in dry matter collection by 3.9-11.7 t / ha, or 34-84% relative to the standard yield corn hybrid Kaskad 195 SV with $HCP_{05} = 1.5$ t / ha (table 4). Among hybrids of KWS selection, the lowest productivity (13.5-14.4 t / ha) formed Ronaldinio and Oferta, the productivity of the Silvinio 26.0 t / ha hybrid was higher by 19-92% than in other studied variants. Of the domestic hybrids Bemo 182 SV and ROSS 199 MV had a significant advantage in productivity by 1.5-4.7 t / ha over the standard.

Table 4: Collection of dry matter of corn hybrids, t / ha

No	Hybrid	2013	2014	2015	2016	Average
1	Kaskad 195 SV st	14,3	11,6	9,4	5,0	10,1
2	Almaz	18,1	12,5	9,9	5,1	11,4
3	Amatus	19,2	14,2	10,2	4,9	12,1
4	Bemo 182 SV	19,0	14,8	12,2	6,1	13,0
5	Klifton	21,9	11,1	11,2	4,6	12,2
6	Korifey	21,7	16,3	11,7	6,2	14,0
7	Oferta	14,4	16,9	10,0	4,7	11,5
8	Ronaldinio	13,5	17,5	10,3	4,5	11,5
9	ROSS 199 MV	15,7	10,4	10,3	4,5	10,2
10	Silvinio	26,0	16,6	16,9	7,6	16,8
Least significant difference LSD_{05}						
Indexlj		6,1	1,9	-1,1	-7,0	

Under the conditions of 2014, corn hybrids formed a relatively low dry matter yield. Varietal response to abiotic conditions in hybrids Oferta and Ronaldinio showed an increase in productivity, unlike other hybrids. The highest dry matter yield of 14.2-17.5 t / ha was formed by the Amatus, Bemo 182 SV, Oferta, Korifey, Ronaldinio, Silvinio hybrids, which is significantly higher compared to the standard Kaskad 195 SV with $LSD_{05} = 1.2$ t / ha. The hybrid ROSS 199 MV in yield was significantly lower than the studied hybrids.

In 2015, the dry matter yield of hybrids on average was 11.2 t / ha by experience, which is lower by 21-39% than in previous years. The Bemo 182 SV, Klifton, Korifey, Ronaldinio, ROSS 199 MV, Silvinio corn hybrids formed productivity significantly higher by 0.9-7.5 t / ha of substance, or 10-80% relative to the yield of the standard Kaskad 195 SV hybrid yield with $LSD_{05} = 0,9$ t / ha. The highest dry matter yield of 16.9 t / ha was formed by a hybrid of KWS Silvinio.

In the unfavorable abiotic conditions of 2016, the accumulation of dry matter was weak and the growth was modest for harvesting. The collection of dry matter was only 4.5-7.6 t / ha. The BEMO 182 SV hybrids, Korifey and Silvinio had a significant productivity advantage of 1.1-2.6 t / ha relative to the standard Kaskad 195 SV hybrid with $LSD_{05} = 0.9$ t / ha. On average, over 4 years of research, corn hybrids have formed a productivity of 10.1-16.8 t / ha of dry matter. Of the hybrids of domestic breeding, the largest dry matter harvest of 13.0 t / ha was provided by Bemo 182 SV; of the hybrids of foreign breeding (KWS), Korifey and Silvinio were the leaders in productivity.

In the cultivation of corn hybrids of different breeding, the cost of seed has a significant impact on the cost of dry matter (Table 5).

Table 5: Economic evaluation of the cultivation of corn hybrids

No	Hybrid	Cost of production, thousand rubles / ha	Production costs, thousand rubles / ha	Net income, thousand rubles / ha	Profitability level,%	Production cost, RUB / t
1	Kaskad 195 SV st	25,2	19,4	5,8	30	539
2	Almaz	28,5	24,9	3,6	14	612
3	Amatus	30,2	25,7	4,5	18	595
4	Bemo 182 SV	32,5	22,6	9,9	43	488
5	Klifton	30,5	25,8	4,7	18	593
6	Korifey	35,0	27,8	7,2	26	556
7	Oferta	28,8	25,0	3,8	15	610
8	Ronaldinio	28,8	25,0	3,8	15	610
9	ROSS 199 MV	25,5	20,3	5,2	26	557
10	Silvinio	42,0	30,9	11,1	36	515

The cost of 1 seed unit, i.e. 80 thousand seeds in hybrids of domestic breeding is 2 thousand rubles. (65-95 thousand rubles. / T), the cost of hybrids breeding company KWS - 5 thousand rubles. (227 thousand rubles / ton). Research in the Uchkhov July IzhGSHA has established that the lowest cost price of dry matter was 488 rubles / ton provided by the domestic selection of Bemo 182 SV. Of hybrids of foreign selection, the relatively low cost of 515 rubles per ton was provided by the Silvinio hybrid with an average yield of dry matter of 16.8 t / ha.

Thus, from the point of view of economic efficiency, the Bemo 182 SV hybrids, Korifey and Silvinio provided for the collection of dry matter of 13.0-16.8 t / ha with the lowest cost of dry matter. The hybrids Kaskad 195 SV and Bemo 182 SV had a relatively low response to changes in abiotic conditions with a linear regression coefficient close to 0, which indicates the formation of a stable yield in the conditions of the region.

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