

The Influence of Sowing Terms and New Generation Antistress Agent on the Productivity of Highly Producing Corn Hybrids of Domestic and Foreign Selection

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The paper considers the research results carried out in the steppe irrigated zone of the Chechen Republic in meadow chernozem-like soils on different sowing terms of different corn hybrids of domestic and foreign selection within various maturity groups. The paper presents information on the impact of the Bioplant Flora antistress agent (organic-mineral nano fertilizers) on growth, development and photosynthetic activity of corn plants of various maturity groups (early-maturing, mid-maturing, and middle-late ones) on the grain yield value of domestic hybrids (VNIKiS) Mashuk-360, K-180, and foreign hybrids (Pioner company) –PR-38-24 at different sowing terms. This paper determines the grain yield volume increase of cultivated hybrids depending on the Bioplant Flora treatment, sowing terms and genotypic features of hybrids. The paper shows the factors forming a high quality grain yield volume of domestic hybrids about 7.6-11.6 t/ha, foreign hybrids about 9.3-14.4 t/ha with Bioplant Flora antistress agent treatment.

Key words: Corn hybrids, Sowing terms, Yield volume, Bioplant Flora.

In the steppe zone of the Chechen Republic, corn is the most high-yielding, fodder-grain crop cultivated on irrigated areas¹. To enhance the bioresource potential of the new high-producing corn hybrids of domestic and foreign selection, it is necessary to establish the optimum

sowing terms in relation to specific soil – climatic conditions combined with the basic agricultural practices of its cultivation technology².

A number of researchers³ found a positive effect of the new generation nano fertilizers, developed on the basis of humic compounds and trace elements on the increase of plants resistance to various stresses (frost, drought, transplanting; increasing the plants resistance to diseases, etc.). Therefore, the researches, aimed at the development, testing and implementation of these

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agro-technical methods, appear to be the urgent task of science and industry.

The purpose of the present research was to determine the optimal sowing terms for corn hybrids of domestic and foreign selection in conjunction with the new organic-mineral nano fertilizer – Bioplant Flora.

Scientific novelty

For the first time within the steppe zone of the Chechen republic, there were carried out researches on determination of the optimal sowing terms for high-producing corn hybrids of domestic (Mashuk-360 and K-180 – VNIKI selections) and foreign (PR-3824 – American selections of the Pioneer company) under irrigated conditions at different sowing terms, with the Bioplant Flora antistress agent treatment, providing reception of 12 or more tons of grain per 1 hectare.

Experimentation procedure

The researches were conducted in 2012-2013, on the fields of the Chechen Scientific and Research Institute of Agriculture. The test area soil is the meadow chernozem-like, carbonate soil with a close occurrence (30-60 cm) of gravel, sometimes cropping out. The humus content in the S horizon works out 3-5%. The upper horizons are characterized by average stock of total nitrogen (0.38%), low phosphorus stock (0.18%), and high potassium stock (1.86%). Effervescence from 10% HCl is strong, pH of soil solution is 6.9-7.1⁴⁻⁶.

The experimental area is characterized by the average air temperature of 9.6+10.4°C and the accumulated temperatures for the frost-free period of 3200-3400°.

An average volume of annual precipitation is 506 mm and the evaporation volume is twice higher, i.e. this area relates to the insufficient moistening zone. Therefore, receiving assured and high yield volumes of corn is possible only under irrigation conditions. As the low moistening threshold, there was adopted the humidity of 1m soil layer – 70-80% of HB (the lowest moisture content). To maintain the level of the soil moisture content, by years were carried out from 3 to 4 vegetation irrigations along the furrows of 500-800 m³/ha, with an irrigation rate of 2050-2800 m³/ha^{7,8}.

The research objects were high-producing, varied in maturity groups corn hybrids: an early-maturing – 180, mid-maturing – Mashuk-

360 and middle-late – PR-3824.

The sowing was carried out in three terms with different amounts of secondary tillage: early sowing term – at temperature of 8-10°C – with one presowing cultivation, middle sowing term – at temperature of 11-13°C – with two presowing cultivations, and late sowing term – at temperature of 14-16°C – with three presowing cultivations.

By the 3rd – 4th days after sowing, there was added a tank mixture of soil-applied herbicides – Merlin (0.08 kg/ha) and trophy (1.25 kg/ha), and at the 3-5 leaves phase the corn crops were sprayed with the dikambelherbicide (0.40 g/ha).

When using highly active herbicides or especially tank agents and their mixtures, it is achieved almost complete inhibition of plant growth; and only in time occurred rain or strong antistress agent treatment can save the crop. Therefore, in recent years agricultural production is increasingly used in combination with herbicides, antistress agent preparations (antidotes), which include “Bioplant Flora”.

Therefore, the seed treatment at sowing was conducted with the application of Bioplant Flora antistress agent (1 l/t) + 2-times treatment of crops: the 1st one – at the 3-5 leaves phase at a rate of 1.0 l/ha, the 2nd one – at the 8-10 leaves phase with the norm of 2.0 l/ha. Spray material consumption – 300 l/ha.

The experiment was carried out in four-time repeatability at the land plots with the total area of 28m², and accounting area of 14m². The sowing method is a wide-row one, with row spacing of 70×21cm, with sowing thickness of 65-70 thousands of plants per a hectare.

Records and observations were carried out by standard methods⁹. Yield data were processed according to Dosphehov B.A.¹⁰.

Research results

It was found that the greatest amount of moisture was spent by the studied hybrids approximately at 10 days prior to the ear emergence and within 20 days thereafter. The main indicator of the efficient use of water by corn is the evapotranspiration ratio (ER), which was dependent on the sowing terms and cultivated hybrids. When cultivating a middle-late hybrid (PR-3824), at an early sowing term, per each unit of dry corn biomass there were spent from 178.1 to 213.8 m³ of water and from 427.6 to 525.3m³ of grain. The

Table 1. The productivity of corn hybrids of domestic and foreign selections according to the different sowing terms and the Bioplant Flora antistress agent treatment (in comparison for the period 2012-2013)

Sowing terms	Background	Hybrids	Yield, t/ha	Increase from					
				Bioplant Flora		Sowing terms		Hybrids	
				t/ha	%	t/ha	%	t/ha	%
Early(8-10°C)	control	K-180	9.5	-	-	+2.7	+28.4	-	-
		Mashuk-360	10.6	-	-	+3.0	+28.3	1.1	10.4
		PR-38K-24	12.6	-	-	+3.6	+28.6	3.1	24.6
	Bioplant Flora	K-180	11.3	1.8	16.0	+3.2	+28.3	-	-
		Mashuk-360	11.9	1.3	10.9	+3.4	+28.5	0.6	5.0
		PR-38K-24	14.4	1.8	12.5	+4.1	+28.4	3.1	21.5
HCP ₀₅ Middle(11-13°C)	control	K-180	6.8	-	-	-	-	-	-
		Mashuk-360	7.6	-	-	-	-	0.8	10.5
		PR-38K-24	9.0	-	-	-	-	2.2	24.4
	Bioplant Flora	K-180	8.1	1.3	16.0	-	-	-	-
		Mashuk-360	8.5	0.9	10.5	-	-	0.4	4.70
		PR-38K-24	10.3	1.3	12.6	-	-	2.2	21.3
HCP ₀₅ Late(14-16°C)	control	K-180	6.1	-	-	-0.7	-10.3	-	-
		Mashuk-360	6.8	-	-	-0.8	-10.5	0.7	10.3
		PR-38K-24	8.1	-	-	-0.9	-10.0	2.0	24.7
	Bioplant Flora	K-180	7.2	1.1	15.2	-0.9	-11.1	-	-
		Mashuk-360	7.6	0.8	10.5	-0.9	-10.6	0.4	5.3
		PR-38K-24	9.3	1.2	12.9	-1.0	-9.7	2.1	22.6
HCP ₀₅		0.31							

lowest value of the evapotranspiration ratio was observed at the cultivation of early-maturing (180 K) and mid-maturing (Mashuk-360) hybrids, amounting the value lower than of the middle-late one by 18.5-13.4% for grain and 16-10% for dry biomass.

The researches showed that the duration of the vegetation period of early-maturing hybrid with early sowing time was 120 days, mid-maturing – 138 days, middle-late – 147 days. When sowing hybrids in the second (middle) period, these figures were: 115; 135 and 141 days, and at the third (late) period – 114; 133 and 139 days.

The maximum leaf area by sowing terms reached to: 46.5; 44.6; 40.9 thousands of m^2/ha , and with the Bioplant Floranano fertilizer treatment it increased up to 49.0 thousands of m^2/ha . It was revealed that the most productive was the environment at an early stage of sowing, when the best result was shown by a middle-late hybrid of American selection – KR-38-24 and mid-maturing hybrid of domestic selection – Mashuk-360.

Thus, the largest leaf area of the studied hybrids of different maturity groups during all vegetation phases was observed at an early stage of sowing with Bioplant Flora nano fertilizer treatment. A higher level of photosynthetic potential (FP) was formed at corn sowing during the early sowing term, when the soil temperature at a depth of seeding was 8-10°C with carrying out a presowing cultivation.

The findings showed that the cultivated hybrids had different bioresource potential depending on the climatic conditions of the zone, the level of applied agricultural technology (herbicides, fertilizers, irrigation, and nano fertilizer treatment) and sowing terms. The productivity of corn hybrids of different maturing groups largely depended on the sowing terms (Table 1).

It is found that the highest grain yield volume was formed at an early term of sowing, when there was the maximum usage of the accumulated for winter moisture, the time of high temperatures occurrence was ahead during the corn fertilization, and the presowing cultivation with harrowing killed the first wave of weeds. In this case, the soil was heated firstly that intensified the activity of microorganisms.

The grain yield volume of early-maturing hybrid (-180) without treatment by the Bioplant

Flora antistress agent amounted to 9.5 t, mid-maturing hybrid (Mashuk-360) – 10.6 t, and middle-late hybrid (PR-38-24) – 12.6 t/ha. The Bioplant Flora antistress agent treatment increased the productivity of cultivated hybrids, respectively by: 1.3; 1.8 and 1.8 t/ha.

At the second (control) term of sowing the yield volume of the cultivated hybrids was slightly decreased: without antistress agent treatment respectively – 2.7; 3.0 and 3.6 t/ha, and with the Bioplant Flora treatment – 1.4; 2.1 and 2.3 t/ha. The productivity of cultivated hybrids at late (third) term of sowing was even lower.

The hybrids sowing during the third term proved to be the most low-yielding one, when they yield volume of the early-maturing hybrid K-180 as compared with the early sowing term decreased by 3.4 (at control) – 4.1 (at Bioplant Flora treatment) t/ha. A similar dependence was also revealed with the mid-maturing hybrid Mashuk-360, which yield volume at the third sowing term was lower than at the first term, respectively, by 3.8 and 4.3 t/ha. The highest yield volume belonged to the middle-late hybrid PR-38A-24 at all sowing terms. At early sowing terms its productivity was higher by 3.6-4.1 tons than at the middle one, and by 4.5-5.1 tons than at the late one.

The tested methods of agricultural technology influenced the crop productivity in different ways. Increase in grain yield volume obtained from the antistress agent (Bioplant Flora) treatment at an early term of sowing comprised by hybrids from 10.9 to 16.0%, at the middle term – from 10.5 to 16.0% and at the late term – from 10.5 to 15.2%.

The optimum corn sowing terms in the steppe zone of the Chechen Republic is considered to be the period when the soil has warmed at a seeding depth up to 12°C, i.e. during the second term. Our research showed that the increase in grain yield volume at early sowing terms (compared to the control) increased by 28.3-28.6% – without Bioplant Flora treatment, and by 28.3-28.5% – with its treatment. However, corn sowing at a later term reduced the grain yield volume by 10.0-10.5% at the control, and by 9.7-11.1% with antistress agent treatment.

Depending on the genotypic features of corn hybrids, the yield volume increase on the control variant at the early term of sowing is by 1.1

to 3.1 t/ha (10.4-24.6%); at the middle term – by 0.8 to 2.2 t/ha (10.5-24.4%), while the later sowing terms – by 0.7 to 2.0 t/ha (10.3-24.7%). Antistress agent treatment helped to improve the productivity of grain respectively to the sowing terms by 5.0-21.5% (early); 4.7-21.3% (middle) and 5.3-22.6% (late).

Consequently, within the irrigated conditions of the Chechen Republic steppe zone, the highest yield volume of corn hybrids of different maturity groups was established at the early sowing terms ($t = 8-10^{\circ}\text{C}$) with a presowing cultivation. Out of the cultivated hybrids, the greatest productivity was shown by the middle-late hybrid of American selection –PR-38-A-24, exceeding the grain yield volume compared to other hybrids on the control at an early stage of sowing by 2.0-3.1 tons, at a middle stage by 1.4-2.2 tons, and at a late stage by 1.3-2.0 t/ha. The Bioplant Flora antistress agent treatment contributed to the formation of grain yield volume up to 12.6-14.4 t/ha.

CONCLUSIONS

For the implementation of bioresource potential of corn in the steppe zone of the Republic on irrigated meadow chernozem-like soils it is necessary to:

1. Perform sowing when the soil temperature at a depth of seed placement (6 to 8 cm) reaches $8-10^{\circ}\text{C}$;
2. Sow mid-maturity hybrid of domestic selection (VNILiS) –MAshuk-360, forming a high-quality grain yield volume of about 7.6-11.6 t/ha, and from the foreign ones –middle-late hybrid of American selection (the Pioner company) –PR-38-24, which provides grain yield volume of 9.3-14.4 t/ha with the Bioplant Flora antistress agent treatment.

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