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AGROECOLOGICAL AND ECONOMIC ASSESSMENT OF CORN HYBRIDS IN THE UDMURT REPUBLIC

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Annotation:

This article discusses the problem of adaptation of corn hybrids to the conditions of the Udmurt Republic. Corn is the main raw material of high quality silage. When cultivating field crops, the variability of quantitative traits is undoubtedly caused by the growing conditions and the "genotype × environment" interaction. An integrated approach to the consideration of this issue showed that the growth of potential productivity of agricultural crops due to breeding and cultivation technology does not reflect favorably on the resistance of new varieties and hybrids to the effects of abiotic and biotic stresses. Studies were performed on sod-medium podzolic medium loamy soil. The topsoil was characterized by an average and high content of humus (2.6–3.2%), a very high content of mobile phosphorus (335–365 mg / kg) and mobile potassium (268–319 mg / kg) and from medium acid to close to neutral by the reaction of pH_{KCl} (5.1-6.4). Long-term studies have revealed that the dry matter yield of 17.6-19.7 t / ha, and the share of cobs in a crop with a waxy ripeness of 40.9-41.9%, can be recommended for cultivation in the production of a hybrid of domestic selection Cascade 166 ASV and hybrids breeding KWS Coryphaeus and Clifton. These hybrids had the lowest cost 438-441 rubles / ton of feed mass.

Key words: *corn hybrids, environmental plasticity, productivity, cost.*

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INTRODUCTION:

The main driver of growth of maize sown areas in the Udmurt Republic as a silage crop is the dynamic development of the livestock industry. The energy value of corn grain is unparalleled. The practice of agricultural organizations of the republic has shown that some corn hybrids are capable of forming more than 10 thousand feed units per hectare. Studies of the Department of Plant Industry of the Izhevsk State Agricultural Academy in the Michurin Agricultural Production Complex of the Vavozhsky District of the Udmurt Republic have convincingly proved the possibility of preparing corn silage with a nutritional value of 0.35 feed units and with a concentration of exchange energy of 12.3 MJ per 1 kg of dry matter.

The efficiency of agricultural production with developed dairy cattle breeding determines the selection of highly productive fodder crops, ensuring the harvesting of high-quality fodder [10].

Fodder production management is one of the most pressing issues in both crop and livestock production [12, 13].
When cultivating for silage in the Non-Chernozem zone of Russia, it is important to obtain green mass of corn with cobs in milky-wax and waxy ripeness of grain, which can be achieved by using early-ripening middle-early maize hybrids for sowing and improving cultivation technology.

The ratio of nutrients changes in the process of maturation in corn plants, the starch content increases to the full ripeness phase, but the sugar content of raw protein decreases. The relative amount of fiber is reduced from 23% in the flowering phase to 19% at the end of waxy ripeness. D. Spaar [9] indicates that corn contains about 28% starch and 10% sugar by the end of wax ripeness.

According to G.A. Romanov [7] to the phase of waxy ripeness of corn grain, the increase in yield to the beginning of the formation of cobs increases 4 times (from 2,370 to 9,604 feed units), and the nutritional value of feed increases from 0.15 to 0.30 feed units in 1 kg of silage.

V.S. Sotchenko, academician of the Russian Academy of Sciences [8] also believes that the feed value of corn silage depends primarily on the content of cobs in the mass and the degree of ripeness of the grain at the time of harvest. A good silage hybrid should provide at least 25-35% of dry matter in the total mass of plants, and the grain content in dry matter should be at least 30%. High-quality silage must contain at least 10.5 MJ of exchangeable energy per 1 kg of dry matter.

In the preparation of feed with given nutritional parameters, the selection of hybrids plays an important role, which are imported, and seed production is impossible due to the natural and climatic conditions of the region.

The role of external factors in the management of the realization of the potential of plants is indisputable. The yield of any variety or hybrid is the result of the work of a complex of important ecological-genetic systems, as a result of which complex quantitative traits are formed. A.A. Zhuchenko [3] proved that the main condition for obtaining the greatest profit per unit of land area is the optimization of the plant-environment system. At the same time, he assigned a large role to the agro-ecological zoning of the territory, which allows for the fuller realization of the potential of varieties and crops. N.I. Vavilov [1] noted: “The harvest is a derivative of the environment and the genotype and is largely determined by the conditions of the culture, the conditions of the area”. A number of researchers [4, 11] associate the adaptability of a variety with its genetic ability to provide stable and high productivity in different environmental conditions. The results of scientific research and world practice prove that a variety or hybrid accounts for about 25-50% in the total share of increasing crop productivity. Scientists have proven that the introduction of new varieties or hybrids into production contributes to an increase in yield by about 1%. In this regard, agricultural production places high demands on hybrids; It is necessary to pay attention not only to the yield, but hybrids should be distinguished by stability and stability. Varieties and hybrids must be tolerant to biotic and abiotic factors of growing conditions, high-tech, that is, an adaptive variety (hybrid) has not only ecological plasticity, but also adapted to optimal conditions and to the manifestation of minimum and maximum values of external factors [5].

METHODOLOGY:

Currently, a comparative study of corn hybrids is underway in the Udmurt Republic. In this connection, the question of studying the parameters of ecological plasticity of hybrids of a given culture is of great scientific and practical importance.

The aim of the research is to study the growth and development of culture in the conditions of the Udmurt Republic, the analysis of the ecological plasticity of hybrids of domestic and foreign breeding and the identification of the most adapted to the

conditions of the region.

The research methodology was generally accepted [2]. The studies were carried out in the southern agroclimatic region of the Udmurt Republic in the Michurin Agricultural and Industrial Complex in the Vavozhsky District of the Udmurt Republic on sod-medium-podzolous medium loamy soil. The topsoil was characterized by an average and high content of humus (2.6–3.2%), a very high content of mobile phosphorus (335–365 mg / kg) and mobile potassium (268–319 mg / kg) and from medium acid to close to neutral by the reaction of pH_{KCl} (5.1-6.4). The soil under the experiments met the requirements of culture.

The experiment scheme included corn hybrids of the early and middle early ripeness group of the Russian Cascade 195 SV, Cascade 166 ASV, Newton MV, Voronezh 158 SV (FNBI VNIIK, Russia) and foreign Coryphaeus, Clifton, Nestor, Ronaldinio (KWS) selection.

Adaptive properties of hybrid maize differing in their origin were calculated according to the method proposed by S.A. Eberhart, W.A. Russel, set forth by Yu.S. Larionov [6].

As a result of the research, it was found that the studied maize hybrids differed in the length of the growing season, which on average varieties amounted to 107-114 days. The data of the experiments showed that the length of the vegetation period mainly depended on the conditions of vegetation and chalk; the inverse strong correlation (r = -0.88) with the yield of dry matter (table 1). The abiotic conditions of 2015 in the initial phases of the development of maize plants were favorable. In the period of leaf formation, when there is an intensive growth of aboveground biomass, hot + 19.8 ... + 20.4 ºC and dry weather of the SCC = 0.5-0.6 was established. In the sweeping phase of panicles, the SCC was 2.6, the average daily air temperature was +15.0 ºC. During the flowering period - milky-wax ripeness, wetting the excess SCC was 1.7-2.7 and the low average daily temperature was + 14.5 ... + 16.6 ° C. When the grain ripened, moisture was optimal SCC 1.1, the average daily air temperature was + 10.5 ºC, which contributed to uniform and fast ripening of the ears in milky-wax ripeness.

The environmental conditions of the growing season of 2016 were characterized by a high average daily temperature and insufficient moisture. Conditions with a hydrothermal coefficient of 0.7 ... 0.4 are very dry, such a phenomenon is observed from sowing to the milky-waxy ripeness of corn hybrids (SCC = 0.1 ... 0.7). The productivity of corn hybrids was influenced by soil moisture. At the depth of the arable layer of the soil, it was only 10.0–10.2% at the critical period of moisture consumption during the "sweeping-blooming" period.

In the conditions of 2017, the growing season was characterized as cool with excessive moisture. During the period of emergence, the average daily temperature did not exceed + 6.7 ... + 7.8 ºC. During the period of intensive growth of maize, meteorological conditions differed in temperature drops from +7.3 ° C to +28.3 ° C with excessive moistening of the SCC = 2.9. This affected the growth and development of plants, and the length of the growing season of corn hybrids increased to 115-121 days, which is 8-14 days longer than in previous years.

A relatively short growing season (100-104 days) in hybrids was noted in 2018. During the leaf formation period, it was hot + 20.3 ... + 25.0 ºC and dry weather was SCC = 0.6. In the period of "flowering - wax ripeness of grain", moisture was optimal (SCC = 0.9), which contributed to the uniform and rapid ripening of the grain.

RESULTS:

On average, over four years of research, the effect on the growth and development of corn hybrids affected the formation of fodder productivity. It was revealed that the dry matter yield had a strong correlation with the mass of plants before harvesting (r = 0.85) and with the share of cobs in the crop (r = 0.93). The coefficient of determination (d_{yx} = 0.73 ... 0.86) indicates that by 73-83% this factor affects the variability of yield.

Table 1 - Correlation of yield of dry matter of corn with the vegetation period and its structure (average 2015-2018)

No	Indicator	Correlation coefficient (r)	Determination coefficient (d_{yx})
1	Vegetation period	-0,88	0,78
2	Plant height	0,41	0,17
3	The proportion of cobs with wax ripeness of grain	0,56	0,31
4	Plant mass	0,85	0,73
5	The proportion of cobs in the harvest	0,93	0,86

The best conditions for the formation of corn yield were formed in 2018. This shows the index of environmental conditions Ij = 6.2 at which, on average, by experience, hybrids formed 22.8 t / ha of dry matter. In 2015, abiotic conditions were less favorable (Ij = 2.2), the productivity of hybrids was 18% lower (18.8 t / ha). On average, by experience, the lowest dry matter yield of 11.2 t / ha maize hybrids formed in unfavorable 2017 with an index of environmental conditions Ij = -5.4 (table 2).

Table 2 - The yield of dry matter of corn hybrids, t / ha

No	Hybrid	2015	2016	2017	2018	The average	The coefficient of variation (V), %
1	Cascade 195 SV (st)	17,0	10,4	9,3	21,4	14,5	39,3
2	Cascade 166 ASV	19,5	12,7	12,5	26,7	17,9	37,7
3	Newton MV	15,6	12,8	9,1	18,7	14,1	29,1
4	Voronezh 158 SV	15,3	12,6	10,1	20,8	14,7	31,2
5	Coryphaeus	21,2	14,6	11,8	22,6	17,6	29,5
6	Clifton	21,7	16,2	13,3	27,5	19,7	31,9
7	Nestor	20,0	14,7	11,3	24,3	17,6	32,6
8	Ronaldinio	20,3	14,5	11,9	20,7	16,9	25,8
9	Average	18,8	13,6	11,2	22,8	-	-
10	Environment Condition Index (Ij)	2,2	-3,0	-5,4	6,2	-	-

The yield of corn hybrids over the years of the study varied considerably, the coefficient of variation of this indicator for the entire period as a whole according to experience is 25.8-39.3%. For four years of research, relatively high yields of 17.6-19.7 t / ha of dry matter have formed hybrids Cascade 166 ASV, Clifton, Coryphaeus and Nestor. These hybrids had an advantage in productivity relative to the standard Cascade 195 SV hybrid and exceeded by 2.5-4.7 t / ha (15-28%) in 2015, by 2.3-5.8 t / ha (22-56%) in 2016, by 2.0-4.0 t / ha (22-43%) in 2017 and by 1.2-6.1 t / ha (6-29 %) in 2018. On average, over four years of research, the Clifton hybrid has formed the highest yield of 19.7 t / ha, which is 1.8-5.6 t / ha, or 10-40% higher than the productivity of other hybrids. Of the hybrids of domestic breeding, a high yield of 17.9 t / ha was characterized by the Cascade 166 ASV hybrid.

To assess the contribution to the yield of its components, factorial analysis was performed. It is believed that high selection efficiency in breeding is expected on grounds, the variability of which is largely due to the genotype. Similar can be noted for the selection of hybrids for cultivation in specific agro-ecological conditions. In our studies, the largest contribution of 44.6-44.8% of the genotype was noted in height and mass of plants (Fig. 1). Therefore, when choosing corn hybrids for cultivation in the Udmurt Republic as a silage crop, it is necessary, first of all, to take into account these indicators. The growth and development of plants, and, consequently, the yield is highly dependent on many environmental factors. This is evidenced by the high contribution to the variability of yield and the share of cobs with waxy ripeness of grain to the harvesting of the “external environment” factor (80.7 and 63.2%, respectively), the share of genotype influence is only 13.5-26.2%. Consequently, the selection of varieties, based on these characteristics, is very difficult.

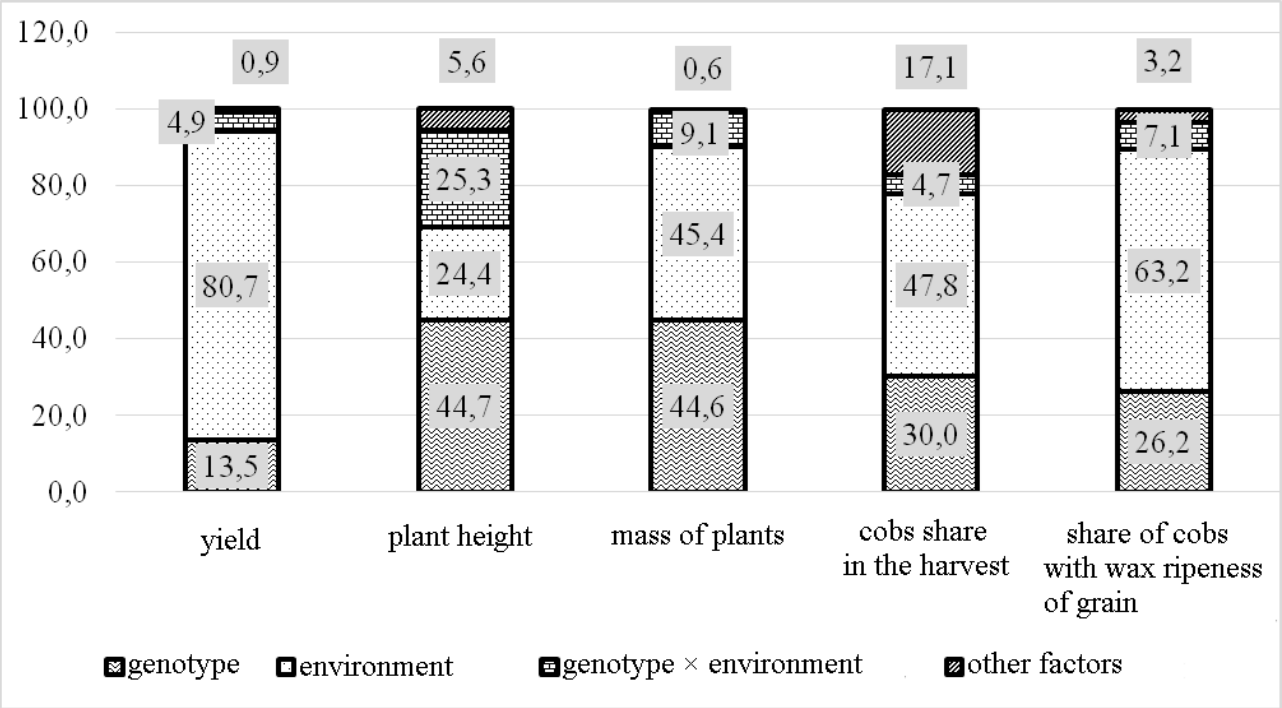

Figure 1 - The contribution of the studied factors to the variability of the main quantitative traits of maize (2015-2018),%

The proportion of "genotype × environment" interaction was higher in the formation of plant height (25.3%) compared to other factors in the formation of the share of cobs in the crop (17.1%), which proves a significant variation of traits depending on the hybrid and the conditions

Thus, for the selection of adaptive hybrids, it is necessary to establish their stress resistance, plasticity, stability.

DISCUSSION:

Stress resistance is determined by the difference between the minimum and maximum value of the indicator. The smaller this gap, the higher the resistance of the variety to stressful growing conditions. Breeding hybrids of the KWS company Ronaldinio and Coryphaeus had increased stress resistance. The decrease in yield of these varieties in extreme conditions was 43-48%, which is 3-14% lower than that of other studied hybrids (table 3).

Table 3 - Parameters of environmental plasticity of corn hybrids

No	Hybrid	Reduced yield in adverse conditions,%	Coefficient of environmental plasticity (bi)	Stability coefficient (S^2d)
1	Cascade 195 SV (st)	57	1,06	0,75
2	Cascade 166 ASV	53	1,25	3,15
3	Newton MV	51	0,75	0,77
4	Voronezh 158 SV	51	0,84	1,29
5	Coryphaeus	48	1,24	5,20
6	Clifton	52	1,23	0,29
7	Nestor	53	1,08	9,29
8	Ronaldinio	43	0,84	2,67

An indicator that indicates the rate of reaction of a genotype with changing environmental factors is the coefficient of environmental plasticity (bi). The higher the coefficient of environmental plasticity (bi> 1), the more responsive this hybrid has. Such hybrids have high demands on cultivation technology. The stability coefficient (S^2d) indicates an adaptive response of the genotype, leading to the correspondence of changes in the state of the characteristics and properties of the organism to changes in agroecological conditions. They are characterized by the degree of its stability [3].

The weak responsiveness to changes in meteorological and edaphic conditions was characterized by Newton MV, Voronezh 158 SV and Ronaldinio, the coefficient of environmental plasticity (bi = 0.75 ... 0.84) of these hybrids was less than 1.0. The remaining hybrids had a higher responsiveness to changes in external factors, their yields were more susceptible to variability.

The hybrids Cascade 195 SV, Newton MV, Clifton (S^2d = 0.29-0.77) were notable for their high resistance to changes in agroecological conditions. The combination of indicators of environmental plasticity (bi = 0.75) and phenotypic stability (S^2d = 0.77) of the Newton MV hybrid indicates its high adaptive properties, while it was characterized by the lowest yield of 14.1 t / ha. This allows the hybrid to be classified as ecologically sustainable, to hybrids capable of producing not very high, but stable yields in any conditions.

The difference in the productivity of corn hybrids influenced the economic efficiency of their cultivation. Hybrids Cascade 166 ASV, Coryphaeus and Clifton provide the fodder mass with the lowest cost of 438-441 rubles / ton (Figure 2).

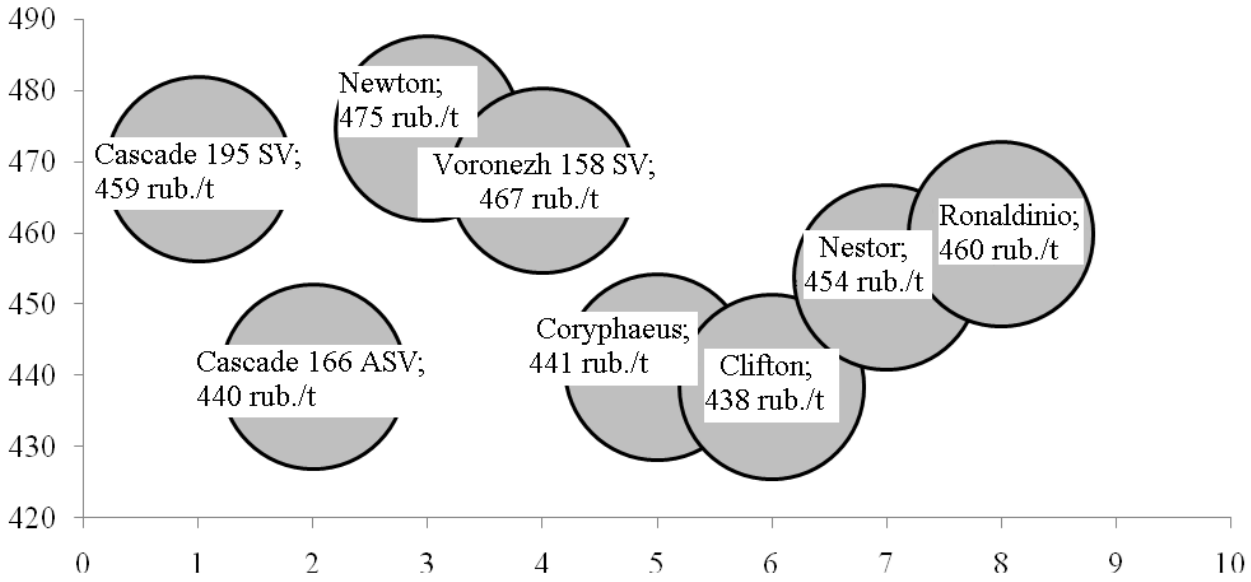

Figure 2 - Cost of feed mass of corn hybrids, rubles / ton

CONCLUSION:

Thus, the analysis of the ecological plasticity of corn hybrids, bred in the southern regions of Russia and abroad, does not always allow their correct selection. In this case, relying on perennial studies on the yield of dry matter of 17.6-19.7 t / ha, and on the proportion of cobs in the crop with a wax ripeness of 40.9-41.9% and the lowest cost of production, a hybrid of domestic selection Cascade 166 ASV and KWS hybrids of breeding Coryphaeus and Clifton may be recommended for cultivation in production.

REFERENCES:

1. Vavilov N. I. 1966. *Osnovnye zadachi sovetskoj selekcii rastenij i puti ih osushchestvleniya* [The main tasks of the Soviet plant breeding and the ways of their implementation]. Moscow, Kolos, P. 114-132.
2. Armor B.A. 1985. *Metodika polevogo opyta* [Field experience]. Moscow, Agropromizdat, P. 351.
3. Zhuchenko A.A. 2003. *Rol' adaptivnoj sistemy selekcii v rastenievodstve XXI veka* [The role of an adaptive breeding system in crop production of the XXI century]. Moscow, ICAR, 1015 p.

4. Zinoviev A.V., Kokonov S.I. 2015. Feed productivity of corn hybrids, depending on the abiotic conditions of the Middle Urals. *Kormoproizvodstvo* [Feed production]. No. 12. P. 31-34.
5. Krivobochek V.G. 2015. Evaluation of the adaptive properties of new varieties of spring soft wheat on the yield in forest-steppe conditions of the Middle Volga. *Niva Povolzh'ya* [Niva Volga]. № 2 (35). Pp. 43-46
6. Larionov Yu.S. 2004. *Upravlenie adaptivnost'yu sorta (teoreticheskie i prakticheskie aspekty)* [Variety adaptability management (theoretical and practical aspects)]. Chelyabinsk: ChSAU, 300 p.
7. Romanov G.A. 2009. *Zhivotnovodstvu – polnocennye korma* [Livestock - complete feed]. Moscow, 410 p.
8. Sotchenko V.S. 2008. Prospects for the cultivation of corn for the production of high-energy feed. *Kukuruza i sorgo* [Maize and sorghum]. No 4. Pp. 2-5.
9. 8. Spaar D., Shlapunov V., Postnikov A. 1999. *Kukuruza* [Corn]. Mn "FUAinform". 192 p.
10. Kislyakova E., Berezkina G., Vorobyeva S., Kokonov S., Strelkov I. 2019. Influence of using seeds of flax and raps in cow rates on the quality of milk and dairy products. Bulgarian Journal of Agricultural Science. Vol. 25. No 1. Pp. 129-133.
11. Kokonov S.I., Khosiev B.N., Valiullina R.D., Ostaev G.Ya., Ryabova T.N., Gogaev O.K. 2019. Production process and economic justification for the cultivation of corn hybrids. Research Journal of Pharmaceutical, Biological and Chemical Sciences. Vol. 10. No 2. Pp. 538-544.
12. Ostaev G.Ya., Khosiev B.N., Gogaev O.K., Mukhina I.A., Kondratev D.V., Markovina E.V. 2018. Beef cattle: methods of management and livestock. Research Journal of Pharmaceutical, Biological and Chemical Sciences. Vol. 9. No 6. Pp. 1678-1686.
13. Rokotyanskaya V.V., Moshchenko O.V., Valuiskov N.V., Ostaev G.Y., Taranova N.S. 2018. Control and analytical management aspects of debtor and credit deposit of enterprises. Journal of Applied Economic Sciences. Vol. 13. No 2 (56). Pp. 446-453.