

Formation of stable agrocenoses of corn hybrids in a sharply continental climate

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Abstract. The article considers the factors influencing the stability of agrocenoses of corn hybrids in the forest-steppe zone of the Krasnoyarsk Territory. The researches were carried out for three years in the zone of sharply continental climate of the Krasnoyarsk forest-steppe on leached low- and medium-thick chernozems. The main factors influencing the stability of agrocenoses of corn hybrids were determined. So the factor of climatic conditions affects the corn hybrids, its influence is no more than 14%. The factor of pre-sowing preparation and the precursor (cereals and fallow) showed not significant effect, no more than 2%, on the formation of agrocenoses of corn hybrids. Thus, the factor genotype of the hybrid was fundamental in determining its significance for agrocenoses. The main biometric factor that determines the productivity of corn hybrids was also identified. Correlation analysis made it possible to reveal the influence of the average plant height on the productivity index of corn, as well as on the ear weight. But at the same time, it was determined that the mass of corn ears decreases with an increase in the average height, in the structure of the crop agrocenoses of corn hybrids.

1. Introduction

With regard to agricultural systems, the stability of agrocenoses implies the production of sufficient quantities of high-quality agricultural products to provide nutrition for the population without damage to the environment, the preservation of natural resources and biodiversity while preserving the income and quality of life of farmers, as well as contributing to the development of rural areas and the economy of the agricultural sector [1]. The stability of agrocenoses is the ability to provide the required quality and quantity of agricultural crops in a long period [2]. Over the past two decades, various models have been developed to assess the stability of agrocenoses at different scales. An initial assessment of the stability of agrocenoses is a key first step in determining the strengths and weaknesses of existing agrocenoses [3].

Natural factors have a significant impact on the growth and development of corn plants and the level of its productivity [4, 5, 6]. Thus, in the subzone of unstable moistening of the left-bank forest-steppe of Ukraine, a higher correlation was observed between climatic indicators and productivity

during the critical growing season of corn [7]. Climate change also accounts for 42% of global variations in corn yield [8]. The creation of stable agrocenoses, taking into account the morphometric and productive parameters of the crop, is not possible without the use of an adaptive and diversified system of corn hybrids [9]. So the result of the structure of the corn harvest also depends on the environmental conditions, the genotype of the line and hybrids [10]. An important factor in the formation of stable agrocenoses is the use of basic tillage, as well as biological feedings and mineral fertilizers [11, 12].

The Krasnoyarsk Territory, located in a zone with a sharply continental climate, where the formation of the climate proceeds under the dominance of the influence of anticyclones, as a result of which spring, winter and autumn are distinguished by a small amount of precipitation. Corn is a thermophilic crop. The required sum of biologically active temperatures (the sum of the average daily air temperatures exceeding the threshold of + 10 ° C) for the maturation of early ripening hybrids is 1800 - 2000 ° C. [13]. The average long-term sum of active temperatures at the Sukhobuzimskoye meteorological station is 1640 ° C. Thus, it has been established that the cultivation of corn in the Krasnoyarsk Territory has its own perspective, only when using early ripening varieties [14].

In the conditions of the forest-steppe zone of the Krasnoyarsk Territory, it is possible to grow corn and grain, however, to ensure the high biological efficiency of the agrocenoses, it is necessary to use an optimal plant protection system [15-18].

Research in this direction is continued by the team of authors in connection with the inhomogeneity of weather conditions, species composition of segetal vegetation, and other factors. The aim of the research was to study the influence of factors on the formation of agrocenoses of corn hybrids in the forest-steppe zone of the Krasnoyarsk Territory.

2. Materials and methods

The researches were carried out in 2018-2020 on the basis of the educational-scientific-production complex "Borskiy" of the Krasnoyarsk State Agrarian University (KSAU) geographically located in the Sukhobuzimsky district, the village of Borsk (56 ° 26'15 "N 92 ° 54'11" E). d.), 50 km north of the regional center. The experimental fields are located in the closed forest-steppe part of the Krasnoyarsk forest-steppe. To assess the principles of the formation of agrocenoses under the influence of abiotic environmental factors, the following indicators were considered in the "soil-plant-climate" system: soil (soil type, chemical composition of soil, crop precursor), plant (culture, biometric indicators, crop productivity) and climatic conditions (factor year).

For testing corn hybrids, two plots were selected: the first plot was the predecessor of pure fallow (site I), the second plot was the predecessor of annual grasses (plot II), the basic tillage in the fall after harvesting the previous crop, disc processing to a depth of 10-12 cm, in the spring - early spring harrowing.

The tillage included pre-sowing cultivation to a depth of 6-8 cm. Leached chernozem is the predominant soil in the farm. Complex of leached chernozems of low and medium thickness heavy loamy granulometric composition. The soils of the experimental plot are characterized by an average humus content (6.3%), a neutral reaction of the medium (pH_{H2O} - 6.6-6.8), and a high total exchangeable bas (42.5 meq / 100g). A survey of the experimental field showed that the arable layer was characterized by a low supply of nitrate (4.68 mg / kg) and ammonium nitrogen (4.54 mg / kg), a high supply of mobile phosphorus (269.2 mg / kg), and a very high supply of exchangeable potassium (174.4 mg / kg). The share of the current ammonification and nitrification is estimated as high because of the large nitrogen carryover by corn hybrids. The provision of agrocenoses with phosphorus and potassium is assessed as very high, thus, the soil fertility of the experimental field is capable of providing high productivity of agricultural crops. In the experiment, we used five double interline and three-line corn hybrids of the originator "P.P. LUKYANENKO NATIONAL GRAIN CENTER" (table 1)

Table 1. Characteristics of corn hybrids.

Hybrid	Ripening period, days	Ripening period (maturity group)	FAO
POCC130MB	80	quickly ripening	130
POCC 140CB	90-92	quickly ripening	140
KRASNODARSKY 194 MB	95-98	quickly ripening	190
POCC 199 MB	97-98	quickly ripening	190
KC 178 CB	97-100	quickly ripening	180

Sowing was carried out with a wide-row TS-M8000A seeder to a depth of 6.0 cm, the seeding rate was 72000 pcs / ha. In the phase of 2-3 leaves of the development of corn hybrids, the crops were treated with defence agents. The active ingredients of the tested herbicide included: 225.0 g / l isoxaflutole + 90.0 g / l thiencazuron-methyl and 150.0 g / l cyprosulfamide (safener).

Statistical processing was carried out using the Microsoft Excel 2010 package. To determine the statistical significance of the differences between the experimental options for individual indicators, one-way and multivariate analysis of variance was used. Correlation analysis was used to identify links between indicators.

3. Results and discussion

Corn is one of the few fodders used for green feed, silage and whole plants. The use of grain cultivation technology for the production of silage, which ensures the production of ears with grain of milky-wax ripeness, involves the assessment of biometric indicators and indicators of productivity of corn hybrids at the final stage of the formation of agrocenoses (table 2).

Table 2. Biometric indicators of hybrids (Hm - height of plants in the phase of milky-wax ripeness, M - yield of green mass).

Hybrid	Hm, cm		M, c/ha	
	plot I	plot II	plot I	plot II
POCC – 199 MB	298.6	279.6	744.0	734.5
KRASNODARSKY 194 MB	289.9	289.9	659.0	550.5
KC 178 CB	276.5	265.5	580.2	600.0
POCC 140 MB	285.5	263.4	500.5	650.0
POCC 130 MB	228.7	225.6	350.6	426.2

Correlation analysis revealed a direct strong effect of average height on the productivity of corn agrocenoses: $R = 0.95$ - for grain precursor, $R = 0.74$ - for fallow (Figure 1).

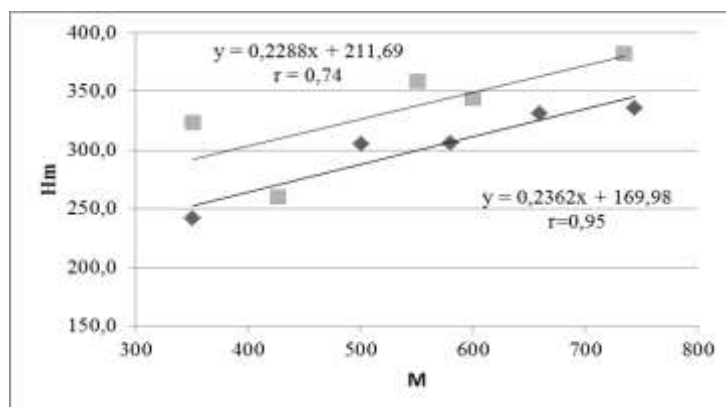


Figure 1. Dot plot with a straight-line correlation between the average height (Hm, cm) and the productivity of corn hybrids (M, c / ha).

The feeding value of silage depends on the content of the ears in the mass and the degree of their ripeness at the time of harvest. It is also generally accepted that during the formation of ears and their ripening, the protein passes from the green mass into the ear.

However, additional correlation analysis (Figure 2) revealed an interesting relationship, average and negative, between average ear weight and average plant height ($R = -0.32$).

4. Conclusions

Revealing reliable differences between the factors and the assessment of their influence allows us to draw the following conclusion. In the conditions of the Krasnoyarsk forest-steppe, for the formation of stable agrocenoses of corn, it is necessary to take into account the biometric indicators and the peculiarities of their genotypic variability when forming the sowing plan. The factor of weather and climatic conditions of the year also showed an effect on the productivity of corn hybrids, but their influence is much lower than the characteristics of the hybrid genotype.

On leached chernozems of low and medium thickness, the precursor does not significantly affect the productivity of corn hybrids. However, the features of the manifestation of the adaptive potential of corn hybrids were revealed. Correlation analysis revealed a significant effect of the average plant height on the yield of green mass of hybrids, while it was confirmed that with an increase in the height of the hybrid, the percentage of ears in the structure of green mass decreases. Consequently, plant height can be a factor determining the stability of corn hybrids in a sharply continental climate and can be an essential indicator in the selection of competing hybrids.

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