AMERICAN JOURNALS
Open Access, Peer Reviewed Journals

American Journal of Technology and Applied Sciences
ISSN (E): 2832-1766 Volume 37, June - 2025

VARIABILITY OF GRAIN PRODUCTIVITY DEPENDING ON CORN SEEDLING DENSITY

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ABSTRACT

Improving livestock productivity largely depends on the development of a robust forage base. This forage base is strengthened through the cultivation of high-nutrition crops on agricultural lands. Among these, corn stands out as one of the most important forage crops in animal husbandry due to its high yield potential. Its cultivation significantly increases the amount of feed units harvested per hectare. Moreover, corn grain is widely used in the production of high-quality compound feeds. One of the key factors in maximizing grain yield is determining the optimal plant density. This article presents the findings of research aimed at identifying the most suitable seedling density for achieving high grain productivity in the newly developed corn variety "Uzbekistan-2018."

KEYWORDS

Animal husbandry, productivity, forage base, fodder crops, corn, grain yield, seedling density, economic efficiency.

Introduction

In recent years, considerable attention has been paid to the livestock sector in Uzbekistan. It is well known that not only in Uzbekistan, but also globally, cattle breeding is considered a leading branch of animal husbandry and plays a key role in supplying the population with high-quality food products such as milk and meat.

One of the main priorities in this sector is to further develop animal husbandry, increase the productivity of farm animals, and significantly expand the production volume of livestock products. To achieve these goals, it is essential to establish a strong forage base and increase the amount of feed units harvested per hectare, taking into account soil and climatic conditions.

Corn is one of the most important forage crops in livestock farming. In addition to its role as a key source of livestock feed, it is also a high-yielding, multi-purpose grain crop. Corn can be used to produce quality concentrates, green mass, and silage. One kilogram of corn grain contains approximately 1.34 feed units.

At present, determining the optimal seedling density for achieving high grain yields from the newly developed corn variety "Uzbekistan-2018" — created by scientists at the Research Institute of Livestock and Poultry — is of particular importance. In the context of global climate change, the development of resource-efficient agrotechnologies for corn cultivation is crucial in ensuring the sustainable production of livestock feed.

The effect of plant density on corn yield has been widely studied by both international and local researchers, including Shmaraev G.G. (1975), Kvyatkovsky A.F. (1980), Shmaraeva G.E. (1985), Severov V.I., Kalashnikov K.G. (1988), Tsikov V.S. (1989), Derov A.I. (1992), Sheshina A.A. et al. (1992), Yankovsky N.G. (1994), Telikh K.M. (1999, 2002), Asyka Yu.A. (2001), Bagrintseva V.N. (2001), Kravtsov I.A. (2001), Petrenko I.M. (2001), Orlyansky N.A., Orlyanskaya N.A. (2005), Massino A.I. (2010, 2011), Azubekov L.Kh., Urusov A.K. (2012), Shindin A.P., Bagrintseva V.N., Borshch T.I., Gorbacheva A.G., Sotchenko V.S., Sotchenko E.F., Sotchenko Yu.V. (2012), Beltukov L.P., Kuvshinova E.K., Tyurin I.M., Kozlov V.A. (2015), Mingalev S.K. (2018), Shmalko I.A., Bagrintseva V.N. (2019), Cherkashina A.V., Sotchenko E.F. (2019), Orlyansky N.A., Orlyanskaya N.A. (2021), Heather Darby, Joe Lauer (2021), Cherkashina A.V. (2021), Gubin S.V., Loginova A.M., Getz G.V. (2022), and Merkulov P.Yu., Mingalev S.K. (2022). These studies have explored the relationship between corn plant density and grain yield.

Materials and Methods

The object of the study was the "Uzbekistan-2018" corn variety. The purpose of the research was to investigate the effect of seedling density on green mass yield.

The study involved field experiments, laboratory analyses, and phenological observations. The research methodology was based on widely accepted guidelines, including "Methodology of Field Experiments with Corn" (Dnipropetrovsk, 1984) and "Methodology of Breeding Experiments with Corn" by I.V. Savchenko (2012).

The data obtained were statistically analyzed using the methodology of B.A. Dospekhov ("Methodology of Field Experiments", Moscow, 1985), as well as modern dispersion analysis methods (ANOVA – Analysis of Variance)

Results and Discussion

Research was conducted to determine the optimal seedling density for achieving maximum grain yield from the "Uzbekistan-2018" corn variety. In experimental plots where the "Uzbekistan-2018" variety was cultivated for grain, the influence of seedling density on grain productivity was specifically studied.

Table 1 presents the grain yield data obtained during the first year of the experiment under various plant density conditions. According to the data in the table, the average grain yields observed at different seedling densities were as follows:At 60,000 plants/ha – 100.2 centners/ha, At 65,000 plants/ha – 105.3 centners/ha, At 70,000 plants/ha – 112.5 centners/ha, At 75,000 plants/ha – 105.6 centners/ha, At 80,000 plants/ha – 102.4 centners/ha,At 85,000 plants/ha – 99.3 centners/ha

Table 1 Grain yield indicators at different seedling densities (2022), c/ha

Variants	Relapces				Average (c/ha)
	1- Relapce	2- Relapce	3- Relapce	4- Relapce	
1-Variant, 60 plants/ha	100,6	98,2	99,8	102,2	100,2
2-Variant, 65 plants/ha	105,4	107,6	103,2	104,8	105,3
3-Variant, 70 plants/ha	110,6	114,6	116,4	108,2	112,5
4-Variant, 75 plants/ha	104,6	106,2	105,4	106	105,6
5-Variant, 80 plants/ha	105,4	101,3	100,6	102,4	102,4
6-Variant, 85 plants/ha	98,4	100,4	99,6	98,7	99,3

These results indicate that the highest grain yield was obtained at a seedling density of 70,000 plants per hectare

The grain yield indicators for the second year of the research are presented in Table 2.

Table 2 Grain yield indicators at different seedling densities (2023), c/ha

Variants	Relapces				Average (c/ha)
	1- Relapce	2- Relapce	3- Relapce	4- Relapce	
1-Variant, 60 plants/ha	105,8	106,4	105,4	108,4	106,5
2-Variant, 65 plants/ha	110,4	112,6	108,6	109,8	110,4
3-Variant, 70 plants/ha	113,8	118,4	120,2	109,2	115,4
4-Variant, 75 plants/ha	106,2	105,6	106,4	110,6	107,2
5-Variant, 80 plants/ha	106,2	108,4	107,2	103,6	106,4
6-Variant, 85 plants/ha	102,4	99,6	101,5	99,8	100,8

According to the data presented in the table, when the crop was planted at a density of 60 thousand plants/ha, the average grain yield was 106.5 c/ha; at 65 thousand plants/ha – 110.4 c/ha; at 70 thousand plants/ha – 115.4 c/ha; at 75 thousand plants/ha – 107.2 c/ha; at 80 thousand plants/ha – 106.4 c/ha; and at 85 thousand plants/ha, the average grain yield was 100.8 c/ha.

The grain yield indicators for the third year of the research are presented in Table 3. According to the data presented in the table, when the crop was planted at a density of 60 thousand plants/ha, the average grain yield was 104.8 c/ha; at 65 thousand plants/ha – 106.6 c/ha; at 70 thousand plants/ha – 113.4 c/ha; at 75 thousand plants/ha – 107.9 c/ha; at 80 thousand plants/ha – 100.1 c/ha; and at 85 thousand plants/ha, the average grain yield was 99.8 c/ha.

Table 3 Grain yield indicators at different seedling densities (2024), c/ha

Variants	Relapces				Average (c/ha)
	1- Relapce	2- Relapce	3- Relapce	4- Relapce	
1-Variant, 60 plants/ha	103,4	102,6	108,4	104,6	104,8
2-Variant, 65 plants/ha	106,8	107,2	105,2	107,2	106,6
3-Variant, 70 plants/ha	110,4	116,4	114,2	112,6	113,4
4-Variant, 75 plants/ha	108,2	109,6	107,4	106,5	107,9
5-Variant, 80 plants/ha	98,6	102,4	100,6	98,8	100,1
6-Variant, 85 plants/ha	100,2	98,6	99,4	100,8	99,8

Over the three years of trials, grain yields were recorded across all variants and replications. The summarized annual averages are presented in Table 4 and visualized in Figure 1.

Table 4 Average grain yield by year and variant (c/ha)

years / **Variants**	Scheme	**1-year 2022**	**2-year 2023**	**3-year 2024**	**Average (c/ha)**
1- variant	70x24,0-1	100,2	106,5	104,8	103,8
2- variant	70x22,0-1	105,3	110,4	106,6	107,4
3- variant	70x20,5-1	112,5	115,4	113,4	113,8
4- variant	70x19,0-1	105,6	107,2	107,9	106,9
5- variant	70x18,0-1	102,4	106,4	100,1	103,0
6- variant	70x17,0-1	99,3	100,8	99,8	100,0

The effect of planting density on grain yield was observed.
From the results presented above, it can be concluded that the 3rd variant (70×20.5–1 planting scheme, 70,000 plants/ha) provided the highest and most consistent grain yields across all three years. Therefore, this seedling density is recommended as the optimal planting scheme for maximizing grain yield in the “Uzbekistan-2018” corn variety.

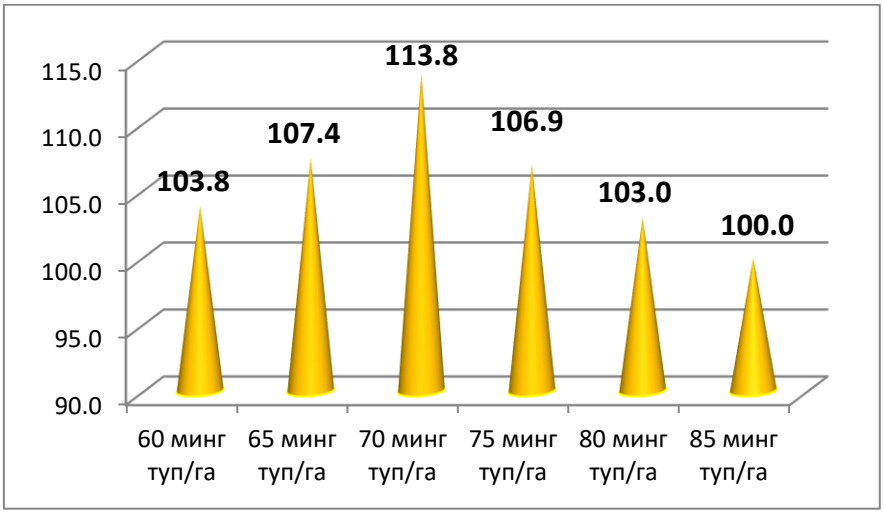

Figure 1. Grain yield indicators in the experimental corn plots sown for grain, c/ha

It is known that the advantages of agrotechnological processes used in cultivating agricultural crops, including corn, are reflected in indicators of economic efficiency. The economic efficiency of sowing the newly created corn variety "Uzbekistan-2018" for grain at different plant densities was analyzed, and the results of the analysis are presented in Table 5 below.

Table 5 Economic efficiency of sowing corn for grain at different plant densities

Variants / Indicators	60- k plants	65- k plants	70- k plants	75- k plants	80- k plants	85- k plants
Grain yield (c/ha)	103,8	107,4	113,8	106,9	103	100
Grain output, %	74,1	74,8	75,9	74,7	73,8	72,5
Net grain yield, c/ha7	76,9	80,3	86,4	79,9	76	72,5
Yield increase vs. control, c/ha	-	3,4	9,5	2,9	-0,9	-4,4
Yield increase vs. control, %	-	4,4	12,3	3,8	-1,2	-5,7
Price per 1 c of grain, thousand UZS	400	400	400	400	400	400
Income from grain yield per ha, thousand UZS	30766,3	32134,1	34549,7	31941,7	30405,6	29000
Production cost per ha, thousand UZS	9000	9000	9000	9000	9000	9000
Price per 1 kg of seed, thousand UZS	15	15	15	15	15	15
1000-grain weight, g	313	308	304,3	297,3	288,7	280,3
Seed required, kg	18,8	20	21,3	22,3	23,1	23,8
Seed cost, thousand UZS	282	300	319,5	334,5	346,5	357
Total expenses, thousand UZS	9282	9300	9319,5	9334,5	9346,5	9357
Net profit, thousand UZS	21484,3	22834,1	25230,2	22607,3	21059,1	19643
Additional net profit vs. control, thousand UZS	-	1349,8	3745,8	1122,9	-425,2	-1841,3
Profitability, %	23,1	24,6	27,1	24,2	22,5	21

In this case, the planting density of 60,000 plants/ha was taken as the control. From the data, it can be observed that up to the density of 70,000 plants/ha, the additional net profit compared to the control increases. The additional net profit was 1,349.8 thousand UZS/ha at 65,000 plants/ha, 3,745.8 thousand UZS/ha at 70,000 plants/ha, and 1,122.9 thousand UZS/ha at 75,000 plants/ha. At 80,000 and 85,000 plants/ha, however, there was a loss of –425.2 thousand UZS/ha and –1842.0 thousand UZS/ha respectively.

Conclusion

Based on the results of the conducted studies and the data presented in the tables and figures above, it can be concluded that as the number of plants increased from 60,000 to 70,000 per hectare, grain yield increased. However, when the density exceeded 70,000 plants/ha, a decrease in grain yield indicators was observed. Thus, for grain cultivation of the corn variety “Uzbekistan-2018,” the most economically effective plant density is 70,000 plants/ha.

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