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PRODUCTIVE POTENTIAL OF COMMON BEAN (*PHASEOLUS VULGARIS* L.) UNDER DIFFERENT SOWING METHODS AND SOWING DENSITY IN THE FOREST-STEPPE OF UKRAINE

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Topicality. *The development and introduction of new adaptive cultivation technologies into production, considering the genotype of the variety, are essential for the effective utilization of the biological potential of bean varieties in Forest Steppe of Ukraine. In order to significantly improve productivity of common bean and increase grain production, a comprehensive study of agrobiological characteristics and bean cultivation technology is required.* ***Purpose****. Investigation of the influence of sowing methods and sowing density on the formation of common bean productivity under climate change in the Forest-Steppe of Ukraine.* ***Methods.*** *Field (laying out trials, performing phenological observations and records), laboratory (determining protein content), measuring and weighing (determining yield attributes), statistical (mathematical processing of research results).* ***Results****. It was established that the highest grain yield of common bean in the agroclimatic conditions of the Forest-Steppe was obtained in all experimental variants with wide-row sowing (on average 3.22 t/ha in Mavka variety and 2.98 t/ha in Panna variety), while in the conventional row sowing it was 2.25 and 2.13 t/ha, respectively. Also, the highest grain yield of common beans was obtained with wide-row sowing method at a plant density of 450,000 plants/ha (Mavka variety – 3.29 t/ha, Panna variety – 3.11 t/ha), with the conventional sowing method at a plant density of 750,000 plants/ha (2.38 and 2.20 t/ha, respectively). The highest protein content was observed in the wide-row sowing method at a plant density of 350,000 plants/ha (22.21 % in Mavka variety, 20.42 % in Panna variety).* ***Conclusions.*** *Sowing methods and plant density significantly influenced all productivity elements of common bean, except for the absolute seed weight. This indicator is largely determined by the variety genotype. Higher productivity of common bean was observed with a wide-row sowing method. The highest yield was in the variant with a plant density of 450,000 plants/ha, the highest protein content in the grain was at a plant density of 350,000 plants/ha.*

Key words: *common bean, sowing method, plant density, productivity, yield, protein content*

Introduction. Modern global trends in the formation of food resources are aimed at solving the problem of protein provision. The decline in the production of high-protein foods of animal origin, as well as the high cost of their production, necessitate an expansion of plant-based protein reservies, including beans, the demand for which has grown significantly in recent years [1, 2].

Among pulses, beans are an important food crop and play a major role in the formation of food and protein resources in many countries, ensuring their food security [3, 4].

The competition for cultivated areas between legumes and other important crops and the rising stress pressure are preventing the increase in their production. Improved cultivation strategies that consider all the methods of producing maximum quantitative and qualitative results under the optimal combination of plant genetic potential, climatic conditions and agronomic practices are the only way out [5].

Common beans are superior to other legumes in terms of protein content and are able to cover the nutritional demands of the human body, especially the processes of growth and development, metabolism, and maintenance of normal life [6]. The special role of common beans in meeting protein demands is primarily determined by their high crude protein content (22–27 %) and the availability of a significant amount of essential amino acids with high digestibility and other quality indicators [4, 7].

Beans are the best source of high quality, amino acid-balanced, economically low-cost and environmentally friendly protein. Therefore,

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they are commonly used for food purposes [6, 8].

In addition, beans are a good predecessor for other crops in the crop rotation, providing the soil with organic matter due to their symbiotic relationship with biological nitrogen, which means that beans are of great agronomic importance [9].

Industrial cultivation of beans in our country remains insufficient, despite the fact that this crop is considered traditional for Ukraine and is in high demand. This is mainly due to the rather low yield of this crop in production conditions, which is a consequence of imperfections in certain elements of the cultivation technology. Efficiency can be improved by introducing high-yielding adapted varieties and improving their cultivation technology [1, 10].

The global climate continues to change at a rapid pace, which in turn increases the risks of agricultural production. Therefore, society is facing the requirement to modernise the traditional model of agricultural production in light of global climate change. Given the local climatic characteristics of the region, we can reduce the negative impact of adverse environmental conditions and maximise the genetic potential of the crop [11, 12].

The development and implementation of new adaptive cultivation technologies, based on the genotype of the bean variety, is crucial for the sustainable utilisation of the biological potential of bean varieties in the Forest-Steppe of Ukraine. A comprehensive study of agrobiological characteristics and cultivation technologies for beans is a prerequisite for a significant enhancement of their productivity and increase in grain production [13, 14].

The research was aimed at studying the effect of sowing methods and sowing density on the formation of common bean productivity under climate changes in the Forest-Steppe of Ukraine.

Materials and Methods. The research was conducted at the Tobacco Research Station of the National Scientific Center "Institute of Agriculture of NAAS". The source material was domestic bean varieties Mavka and Panna of conventional selection of the NSC "Institute of Agriculture of NAAS". Common bean was sown in the early May, given the current weather conditions. Wide-row (row spacing of 45 cm) and conventional row (row spacing of 15 cm) sowing methods were used with plant density of 350, 450 and 650, 750 thousand plants/ha, respectively. The area of the registration plot was 8 m^2, the experiment was repeated three times. The soil of the experimental field is podzolised chernozem with a humus content of 3.31 % in the topsoil (0–30 cm).

The Tobacco Research Station is located in a zone of unstable moisture. The average annual precipitation is 470–490 mm, of which 300–310 mm falls during the period with temperatures above +10 °C. The weather conditions during the research period (2021–2022) varied significantly. In 2021, the moisture availability of plants was sufficient at all stages of ontogeny (HTC = 1.31), and June was excessively wet (HTC = 1.77). In 2022, the weather conditions were rather dry. There was a significant shortage of precipitation in all months of the growing season, especially in July (only 32.2 % of the long-term average). In general, the growing season in 2022 was characterised as moderately dry (HTC = 0.55). By month, the hydrothermal coefficient was 0.60 in June, 0.65 in August (medium-dry), and 0.52 and 0.43 in May and July (severely dry), respectively. The temperature regime during these years exceeded the long-term average by 2.0–4.2 °C.

Results and Discussion. Among the important elements of cultivation technology that significantly increase the yield and quality of bean grain is the spatial and quantitative arrangement of plants on the area, which is determined by the sowing method and plant density.

According to the analysis of common bean productivity elements, it was found that their values were higher in the wide-row sowing method than in the conventional row sowing method in all variants of the experiment (Table 1).

The number of pods per plant varied from 15.4 to 19.1 pcs in Mavka variety and from 11.8 to 15.1 pcs in Panna variety. A tendency to increase the number of pods and the number of seeds in them was observed with the wide-row sowing method (Mavka variety – 18.7–9.1 pods with 6.1–6.2 seeds, Panna variety – 14.6–15.1 pods with 4.6–4.7 seeds). A greater number of seeds per pod and their weight per plant were observed in the Mavka variety. The highest values were in the variant with a wide-row sowing method at a plant density of 350 thousand plants/ha (116.4 pcs and 23.5 g), the lowest –

Table 1. Productivity elements of common bean plants depending on the sowing method and sowing density, average for 2021–2022

Sowing method (factor A)	Plant density, thousand plant/ha (factor Б)	Number, pcs.			Weight, g	
		pods per plant	seeds per pod	seeds per plant	seeds per plant	1000 seeds
Mavka variety						
Wide-row, 45 cm	350	19.1	6.1	116.4	23.5	202.5
	450	18.7	6.2	115.9	23.2	199.8
Conventional row, 15 cm	650	16.8	6.0	100.6	19.8	196.5
	750	15.4	5.8	90.2	17.6	195.6
Average		17.5	6.0	105.8	21.0	198.6
Panna variety						
Wide-row, 45 cm	350	15.1	4.6	69.3	19.7	284.5
	450	14.6	4.7	68.6	19.2	280.2
Conventional row, 15 cm	650	12.7	4.4	55.8	15.5	278.4
	750	11.8	4.3	50.5	14.0	276.8
Average		13.6	4.5	61.1	17.1	280.0
LSD_{05} (A)		*0.9*	*0.4*	*3.8*	*0.8*	*12.0*
LSD_{05} (Б)		*0.9*	*0.3*	*4.4*	*0.8*	*13.4*

in the variant with a conventional row sowing method (750,000 plants/ha) – 90.2 pcs and 17.6 g, respectively. In the Panna variety, the highest values of these indicators were in the variant with a wide-row sowing at a plant density of 350,000 plants/ha (69.3 pcs and 19.7 g), the lowest values were in the conventional row sowing method (750,000 plants/ha) – 50.5 pcs and 14.0 g, respectively.

The 1000 seed weight of the Mavka variety in all variants was within 195.6–202.5 g, and the Panna variety – 276.8–284.5 g. These indicators are determined not only by the elements of cultivation technology, but also by the genotype of the studied varieties. The maximum 1000 seed weight was obtained with a wide-row sowing method: in the Mavka variety – 199.8–202.5 g, in the Panna variety – 280.2–284.5 g.

According to the results of the research, it was found that the highest yield of common bean grain, on average, for all variants of the experiment in the agroclimatic conditions of the Forest-Steppe zone was 3.22 t/ha in the Mavka variety and 2.98 t/ha in the Panna variety under the wide-row sowing method. Under the conventional row method, yield was 2.25 and 2.13 t/ha, respectively (Fig. 1).

The highest grain yield of common bean was

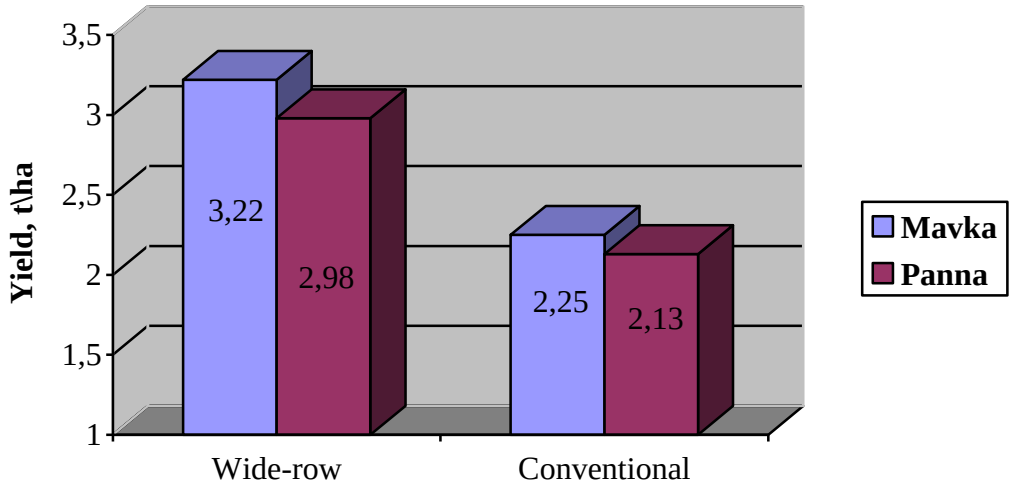

Fig. 1. Common bean grain yield depending on the sowing method, average for 2021–2022.

observed at a plant density of 450,000 plants/ha under wide-row sowing method. Thus, the Mavka variety produced a yield of 3.29 t/ha, and the Panna variety – 3.11 t/ha. Under the conventional method of sowing, the highest yield of bean grain for all varieties was obtained at a plant density of 750,000 plants/ha – 2.38 and 2.20 t/ha, respectively (Fig. 2).

Over the years of research, the average

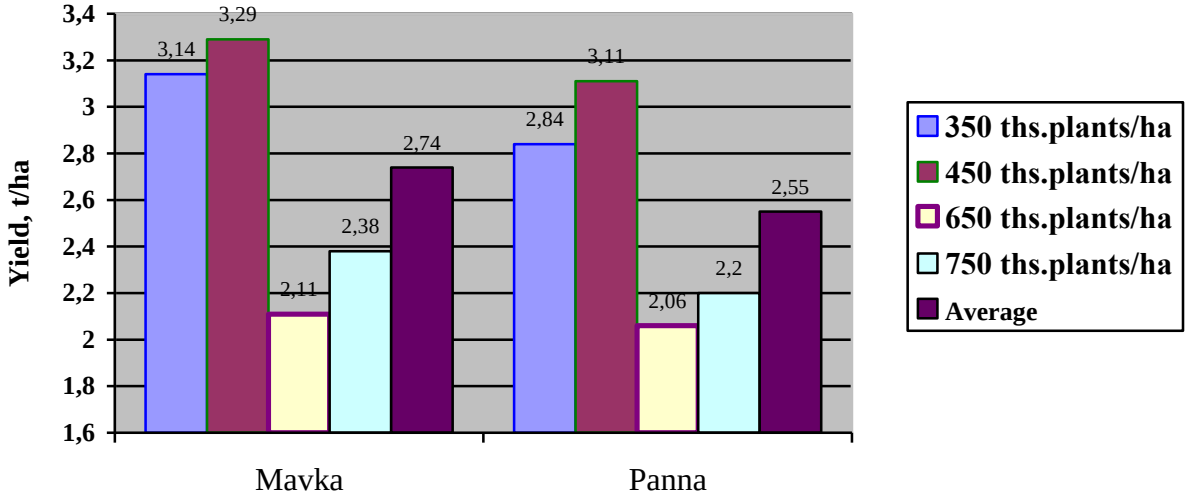

Fig. 2. Common bean grain yield depending on plant density, average for 2021–2022.

protein content in bean grain of the Mavka variety was 21.44 %, and that of the Panna variety was 20.29 % (Fig. 3).

Depending on the common bean genotype,

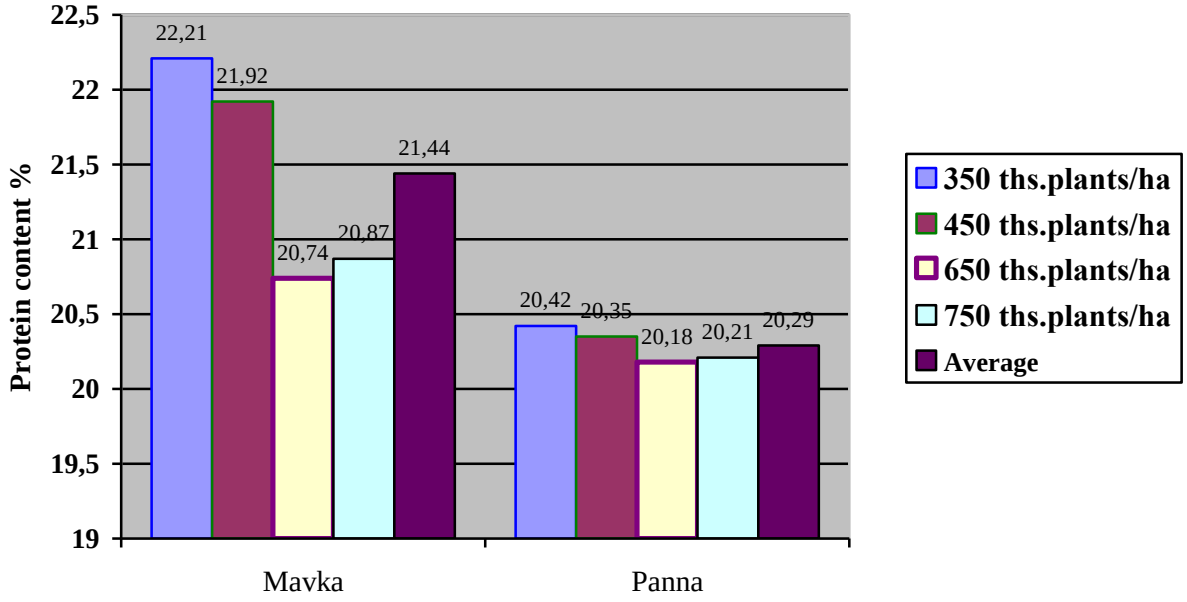

Fig. 3 Protein content in common bean grain depending on plant density, average for 2021–2022.

the Mavka variety was characterised by higher protein content in grain. The best variants in terms of this trait were obtained in the experiments with wide-row sowing method.

The highest protein content (22.21 % and 21.92 %) was observed in the Mavka variety when sown at a plant density of 350 and 450 thousand plants/ha. In the Panna variety, under the same growing conditions, the protein content in the grain was 20.42 % and 20.35 %, respectively.

Conclusions. Sowing methods and plant density significantly impacted all elements of common bean productivity, except for the 1000

seed weight. This indicator was largely determined by the genotype of the common bean variety. Higher productivity of common bean was observed under the wide-row sowing method. The highest yield was in the variant with a plant density of 450,000 plants/ha, and the protein content in grain was at a plant density of 350,000 plants/ha.

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Парфенюк О. О., Труш С. Г., Баланюк Л. О. Продуктивний потенціал квасолі звичайної за різних способів сівби та густоти посіву в Лісостепу України. *Зернові культури. 2023. 7 (2). 309–314.*

Дослідна станція тютюнництва Національного наукового центру «Інститут землеробства НААН», вул. Інтернаціональна,4, м. Умань, Черкаська обл., 20300, Україна

Актуальність. Для ефективного використання біологічного потенціалу сортів квасолі в умовах Лісостепу важливе значення має розроблення та впровадження у виробництво нових адаптивних технологій вирощування з врахуванням генотипу сорту. Всебічне вивчення агробіологічних особливостей та технології вирощування квасолі є однією з умов істотного підвищення її продуктивності та збільшення виробництва зерна. **Мета досліджень.** Вивчення впливу способів сівби та густоти посіву на формування продуктивності квасолі звичайної за кліматичних змін у Лісостепу України. **Методи.** Польовий (закладання дослідів, фенологічні спостереження і обліки), лабораторний (визначення вмісту білка), вимірювально-ваговий (визначення елементів структури врожаю), статистичний (математична обробка отриманих результатів досліджень). **Результати.** Установлено, що в агрокліматичних

умовах Лісостепу найвища врожайність зерна квасолі звичайної за всіма варіантами досліду була за широкорядного способу сівби (в середньому 3,22 т/га – у сорту Мавка і 2,98 т/га – у сорту Панна). За звичайного рядкового вона становила 2,25 і 2,13 т/га відповідно. За широкорядної сівби найвищу врожайність зерна квасолі звичайної отримали за густоти стояння рослин 450 тис. шт/га. (у сорту Мавка –3,29 т/га, сорту Панна – 3,11 т/га). За звичайного способу сівби вищу врожайність зерна квасолі за всіма сортами одержано при густоті стояння рослин 750 тис. шт/га (2,38 і 2,20 т/га відповідно). Найвищий вміст білка спостерігався за широкорядного способу сівби за густоти стояння рослин 350 тис. шт/га (22,21 % – у сорту Мавка, 20,42 % – у сорту Панна). **Висновки.** Способи сівби і густота рослин мали істотно впливали на всі елементи продуктивності квасолі звичайної, окрім абсолютної ваги насіння. Цей показник більшою мірою був обумовлений генотипом сорту. Вища продуктивність квасолі звичайної спостерігалася за широкорядного способу сівби. Найвища врожайність була у варіанті з густотою стояння рослин 450 тис. шт/га, вміст білка в зерні – за густоти стояння рослин 350 тис.шт/га.

Ключові слова: *квасоля звичайна, спосіб сівби, густота рослин, продуктивність, урожайність, вміст білка*