

MORPHOLOGICAL FEATURES AND YIELD OF MALTING SPRING BARLEY VARIETIES DEPENDING ON GROWING CONDITIONS

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Topicality. Increasing demand for malting barley encourages breeders to develop new varieties that combine a high yields and grain quality with resistance to adverse environmental conditions. Today, the introduction of highly adaptive spring barley varieties of both domestic and foreign breeding, which are capable of increasing the realisation of their productivity potential and the stability of grain production, is of great importance. **Purpose.** To study the formation characteristics of morphological traits, productivity elements and yield attributes of malting spring barley varieties of foreign selection depending on the nutritional background and weather conditions of the year. **Materials and Methods.** The trials were laid out on two nutrition backgrounds: 1st – no fertilisers; 2nd – $N_{30}P_{30}K_{30}$. Twelve foreign varieties of malting barley were studied. Laboratory, field, calculation and statistical methods were used. **Results.** It was established that the growth, development and formation of productivity elements of malting spring barley varieties were significantly influenced by the weather conditions of the growing season and the nutritional background. Averaged over the years (2021 and 2023) on the background without fertilizers, the highest number of productive stems was formed by Skyway and Quench varieties (560–580 pcs/m²), and on the fertilized one, by Odyssey, Guzel and Lexy varieties (680–690 pcs/m²) with productive tillering, respectively, 1.8–2.0. BARI, Evgenia and Planet varieties provided the largest number of grains per spike on both backgrounds, from 20.0 to 22.8 pcs. Guzel and Evgenia varieties had the highest grain size, with the 1000 grain weight of 47.1–50.0 g on the background without fertilizers, and 50.2–50.7 g, on the fertilized background. The greatest response to fertilisation was observed in Odyssey, Guzel and Lexy varieties, which provided an increase in grain yield of 66.2–76.1% in accordance with biological yield data. Actual yields on the background without fertilisers ranged from 2.43 t/ha (Odyssey) to 3.06 t/ha (Lexy), with an average yield of 2.73 t/ha. At the same time, Lexy Guzel, Evgenia and BARI varieties stood out with yields of 2.83–3.06 t/ha. The maximum increase in grain yields was provided by Odyssey (1.41 t/ha) and Fandaga (1.39 t/ha) varieties on the background of $N_{30}P_{30}K_{30}$. The greatest variety effect (+0.31 t/ha) with a grain yield increase of 8.6 % was observed in Lexy variety, compared to the average yield by varieties (3.30 t/ha). **Conclusions.** Lexy, Evgenia and Guzel varieties can be considered the most suitable for cultivation in the eastern part of the Forest-Steppe of Ukraine, as they produced the highest grain yields and had the most positive response to fertilisers regardless of the growing conditions.

Key words: spring barley, malting varieties, fertilisers, yield attributes, productivity, yield

Introduction. Plant genetic diversity is the key to developing new varieties of field crops to enhance food production and food security. Among agricultural crops, spring barley

(*Hordeum vulgare* L.) has been and remains one of the main cereal spiked crops, ranking second in terms of sown area and gross harvest in Ukraine after winter wheat. This is explained

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by its food, grain and fodder and technical value, high yield, and unpretentiousness to growing conditions [1, 2]. Barley grain in the form as malt is an excellent source of nutrients for yeast in the brewing process, which is especially important for the brewing industry. The cultivation of malting barley has certain peculiarities, as it involves meeting the requirements of producers both in terms of grain yield and specific quality criteria. In addition, there are significant genotypic and environmental differences in these indicators [3]. The important place of the variety in the production of high-quality raw materials for the malt and brewing industries has been established [4, 5]. The productivity and quality of malting barley are largely influenced by the genotype and the environment [6, 7].

Mineral fertilisers contribute to better plant growth and development, and the formation of productive tillering and biomass. Optimisation of plant nutrition through fertiliser application can provide a 40–50 % increase in grain yield [8]. The level of barley productivity significantly depends on the number of productive shoots, spike length, number and weight of grains per spike and other elements of the yield attributes [9]. The stem of a plant is the main organ that determines the development and accumulation of vegetative mass of plants. Plant height characterises the response of the plant to growing conditions and is determined by the genetic characteristics of the variety. During the tillering – stem elongation period, the plants are almost the same height, and their intensive growth in height occurs from the heading stage to the milky-wax ripeness stage [10].

Today, most authors emphasise that modern barley varieties must combine high yield and stability in a changing environment. It is noted that grain yields significantly depend on the weather conditions of the year [2, 7]. Therefore, studies on the response of varieties to fertilisation in spring barley cultivation are relevant, as they can change the habitus and characteristics of individual plant productivity.

The bioclimatic potential of the Eastern Forest-Steppe zone of Ukraine provides every opportunity to produce high-quality brewing raw materials. For this purpose, it is advisable to implement varieties that are better adapted to local growing conditions [11]. The involvement of new high-yielding malting barley varieties of

foreign selection in the agro-technological process will help to identify the most adapted to the growing conditions in terms of yield and grain quality and the advisability of their implementation in production.

The research objective is to study the peculiarities of formation of morphological characteristics, productivity elements and yield of malting spring barley varieties of foreign selection depending on the nutrition background and weather conditions of the year.

Materials and Methods. The research was carried out in field crop rotation at the Yuriev Institute of Plant Production of the National Academy of Agrarian Sciences of Ukraine during 2021 and 2023. The experiments were laid down on two nutrition backgrounds: 1st – no fertilisers; 2nd – N₃₀P₃₀K₃₀. The predecessor was soybean. We studied twelve foreign barley varieties for malting purposes (Table 1). Plots were arranged systematically in one tier, the total plot area was 37.0 m², and the registration area was 24.0 m². Agricultural technology is generally accepted for the growing area. Laboratory, field, calculation and statistical methods were used in the research process [12, 13]. During the experiments on the study of growth and development of spring barley plants, we were guided by generally accepted methods and recommendations [11, 14].

Fluctuations in the hydrothermal regime significantly affected the production process and allowed us to identify the response of spring barley varieties to fertilisation. As it is well-known, potential productivity is realised to a lesser extent under unfavourable conditions, but adaptability indicators are better manifested. The experiments revealed a high degree of dependence of the yield of varieties on the moisture availability of a particular growing season.

During the years of research, the weather conditions in spring barley vegetation were different, which gave an opportunity to assess the advantages of a particular barley variety depending on the nutrition background. Thus, the first half of the growing season in 2021 was characterised by low temperatures and sufficient precipitation, and the second half by high temperatures in the absence of productive rainfalls.

The average daily air temperature in April was 8.3 °C, and in May – 15.8 °C, which is 0.3 °C and 1.3 °C lower than the long-term ave-

Table 1. Characteristics of the malting spring barley varieties

Variety	Subspecies	Maturity group	Breeder, country of origin
Fandaga	two-row	mid-ripening	Nordsaat, Saatzucht GMBH, Germany
Gulliver	two-row	mid-ripening	Secobra Rechearches S.A.S, France
Evgenia	two-row	mid-ripening	Secobra Rechearches S.A.S, France
Odyssey	two-row	mid-ripening	Limagrain Cereal Seeds, France
Planet	two-row	mid-ripening	RAGT Semences, France
Avalon	two-row	mid-ripening	Saatzucht Josef Breun, Germany
BARI	two-row	mid-ripening	Anheuser-Busch, USA
Fatima	two-row	mid-ripening	Saatzucht Josef Breun, Germany
Lexy	two-row	mid-ripening	Saatzucht Josef Breun, Germany
Quench	two-row	mid-ripening	Syngenta Seeds, Switzerland
Guzel	two-row	mid-ripening	Secobra Rechearches S.A.S, France
Skyway	two-row	mid-ripening	Secobra Rechearches S.A.S, France

rage, respectively.

The amount of precipitation in April (40 mm) and May (106.3 mm) equalled 113 % and 143 % of the long-term average, which contributed to further plant growth and development, especially during the formation of the flag leaf. In June, the average daily air temperature was 20.6 °C, which was 0.4 °C higher than the long-term average, and the amount of precipitation was 38 mm, which was 40 % lower than the long-term average. The total precipitation during the growing season was 184.3 mm or 86 % of the long-term average. In April 2023, precipitation was 68.0 mm or 192 % of the long-term average, which contributed to sufficient soil moisture availability, and the average air temperature was 10.9 °C, which was 1.3 °C higher than the long-term average. In May, the amount of precipitation was 76.0 % of the long-term average, and the air temperature was 15.8 °C, which was also 1.3 °C lower than the long-term average. No significant negative impact on the development of the studied varieties was observed. The average monthly air temperature in June was at the level of long-term data (20.2 °C), and the amount of precipitation was 39 mm, which was only 62.0 % of the long-term average. Thus, the second half of the growing season of spring barley varieties was characterised by dry weather with a deficit of precipitation.

Results and Discussion. According to the results of the analysis of field germination of seeds both on the background without fertilisers and on the fertilised background (N₃₀P₃₀K₃₀), the highest field germination rates were observed in Fandaga (89–92 %), Gulliver (89 %) and Odyssey (88 %). The lowest field germina-

tion rate on both backgrounds was observed in Planet variety (79–81 %), and on the fertilised background – in varieties Skyway (76 %), Fatima (81 %), Guzel (81 %), BARI (83 %) and Evgenia (84 %) (Table 2).

Significant variation in the total and productive plant density of spring barley varieties was observed during the years of research. Under the introduction of N₃₀P₃₀K₃₀, compared to the variants without fertilizers, the structural parameters of spring barley plants were significantly better (Table 3).

It was found that the plant density decreased during the growing season, while the number of productive stems increased. In the tillering stage, the formation of lateral stems compensated for the loss of a part of plants, and intensive tillering increased the number of productive stems. The difference in the biometric data of plants also affected the indicators of the yield attributes of the varieties. On average, in 2021 and 2023, BARI and Quench varieties had the largest number of plants in the tillering stage on the nonfertilised background – 400 plants per 1 m².

The lowest number of plants was in Fatima and Guzel varieties (270–280 plants/m²). The highest number of plants on the fertilised background was in the varieties Guzel (370 plants/m²), Lexy (390 plants/m²) and Avalon (400 plants/m²), and the lowest – in Planet variety (280 plants/m²). Overall plant tillering varied from 1.7 shoots (BARI) to 2.3 shoots (Guzel) on the nonfertilised background, and from 1.9 shoots (Evgenia and BARI) to 2.5 shoots per plant (Gulliver) on the fertilised background.

According to the research of A. V. Panfiova, V. V. Hamaiunova, the formation of spring barley productivity elements, namely the number of grains per spike and grain weight, depended on the variety and plant nutrition variant [15]. Under the conditions of unstable moisture supply over

the years of research, the introduction of mineral fertilisers contributed to better plant growth and development, the formation of productive tillering and grain weight, which provided a significant advantage in the yield of varieties compared to the background without fertilisers.

Table 2. Field germination of spring barley varieties depending on the nutrition background, %

Variety	Years		Average
	2021	2023	
Nonfertilised background			
Fandaga	95	83	89
Gulliver	93	86	89
Evgenia	85	79	82
Odyssey	92	85	88
Planet	81	78	79
Avalon	93	79	86
BARI	86	80	83
Fatima	92	73	82
Lexy	93	75	84
Quench	90	77	83
Guzel	86	84	85
Skyway	82	83	82
Fertilised background – N ₃₀ P ₃₀ K ₃₀			
Fandaga	95	90	92
Gulliver	92	87	89
Evgenia	89	80	84
Odyssey	93	84	88
Planet	84	79	81
Avalon	90	83	86
BARI	86	80	83
Fatima	91	72	81
Lexy	93	79	86
Quench	90	84	87
Guzel	84	79	81
Skyway	70	82	76
LSD ₀₅ A – (background)	1	3	3
LSD ₀₅ B – (variety)	2	9	7
LSD ₀₅ AB – (interaction)	4	13	10

The total number of shoots on the background without fertilisers varied from 590 (Guzel) to 830 pcs/m² (Quench), and on the fertilised background – from 660 pcs/m² (Evgenia and Planet) to 820 pcs/m² (Guzel). On the non-fertilised background, the lowest number of productive shoots was formed by Planet, Guzel, Evgenia and Fatima (450–470 pcs/m²); and the coefficient of productive tillering was 1.4, 1.7, 1.3 and 1.7, respectively. Skyway and Quench varieties had the highest number of productive stems (560 pcs/m² and 580 pcs/m²) and the productive tillering coefficient was at the level of 1.5. On the fertilised background, Planet, BARI

and Evgenia varieties formed productive stems of 510–550 pcs/m² with the tillering coefficient in the range of 1.5–1.8. The maximum number of productive stems was formed by Odyssey, Guzel and Lexy varieties (680–690 pcs/m²) with the highest tillering coefficients (1.8–2.0). According to the correlation analysis, in 2021 and 2023, a moderate positive correlation was found between productive tillering and yield, r=0.6 and r=0.3, respectively. A moderate positive correlation between the number of productive stems and yield was observed in 2021 (r=0.5), as well as a strong one (r=0.8) in 2023.

It was noted that the indicators of the yield

attributes of spring barley varieties differed significantly by years of research (Table 4). On average for two years, the highest plant height on both nutrition backgrounds was in the BARI

variety (58.9–65.7 cm). This indicator was the lowest in Odyssey variety (48.0 cm) on the background without fertiliser, and in Quench variety (55.5 cm) on the fertilised background.

Table 3. Productivity indicators of spring barley varieties depending on the nutrition background, average for 2021, 2023

Variety (factor B)	Number of plants, pcs/m ²	Total number of shoots, pcs/m ²	Number of productive stems, pcs/m ²	Coefficient of total tillering	Coefficient of productive tillering
Nonfertilised background (factor A)					
Fandaga	330	690	490	2.1	1.5
Gulliver	320	650	520	1.9	1.6
Evgenia	380	730	470	1.9	1.3
Odyssey	330	670	490	2.0	1.5
Planet	320	660	450	2.0	1.4
Avalon	350	710	490	2.0	1.4
BARI	400	680	490	1.7	1.3
Fatima	270	600	470	2.2	1.7
Lexy	370	660	500	1.9	1.4
Quench	400	830	580	2.1	1.5
Guzel	280	590	450	2.3	1.7
Skyway	370	740	560	2.0	1.5
Fertilised background – N ₃₀ P ₃₀ K ₃₀					
Fandaga	340	740	580	2.2	1.7
Gulliver	300	730	580	2.5	2.0
Evgenia	360	660	550	1.9	1.6
Odyssey	340	810	680	2.4	1.9
Planet	280	660	510	2.3	1.8
Avalon	400	770	620	2.1	1.7
BARI	350	700	540	1.9	1.5
Fatima	320	760	610	2.3	1.9
Lexy	390	800	690	2.0	1.8
Quench	340	750	590	2.2	1.8
Guzel	370	820	680	2.4	2.0
LSD ₀₅ :A	34	73	46	0.3	0.1
LSD ₀₅ : B	83	178	113	0.6	0.3
LSD ₀₅ : AB	117	251	159	0.9	0.5

The correlation analysis of plant height and yield showed a strong positive correlation (r=0.7) in 2021 and an average one (r=0.6) in 2023. It should be noted that I. Öztürk [17] found a negative correlation between grain yield and plant height of spring barley.

The spike length varied from 6.3 cm (Lexy) to 7.0 cm (Planet and Avalon) on the non-fertilised background, and from 6.7 cm (Guzel) to 7.9 cm (Odyssey and Planet) on the fertilised background. According to the correlation analysis, a moderate positive correlation was found between spike length and yield in 2021 and 2023 (r=0.5 and r=0.4, respectively). Our data confirmed the generalised conclusions of M. Kas-

sie and K. Tesfaye [17] regarding the dependence of barley grain yield on the number of shoots and spikes per 1 m², spike length and number of grains per spike.

According to our data, in terms of the number of grains per spike on both backgrounds, BARI (22.2–22.8 pcs.), Evgenia (20.9–22.5 pcs.) and Planet (20.0–22.4 pcs.) varieties stood out. The lowest values were recorded for Odyssey on the nonfertilised background (18.0 pcs.) and Fatima in the variant with fertilisers (19.8 pcs.). A moderate positive correlation was established between the number of grains per spike and yield in 2021 and 2023 (r=0.3).

Table 4. Yield attributes of spring barley varieties depending on the nutrition background (average for 2021, 2023)

Variety (factor B)	Plant height, cm	Spike length, cm	Number of grains per spike, pcs.	1000 grain weight, g	Biological yield, t/ha
Nonfertilised background (factor A)					
Fandaga	48.8	6.5	19.7	44.2	4.41
Gulliver	50.8	6.9	19.3	45.2	4.64
Evgenia	53.4	6.6	20.9	47.1	4.73
Odyssey	48.0	6.4	18.0	42.0	3.82
Planet	53.8	7.0	20.0	45.0	4.09
Avalon	55.0	7.0	19.9	47.5	4.75
BARI	58.9	6.5	22.2	41.4	4.94
Fatima	50.0	6.6	18.9	46.2	4.15
Lexy	50.7	6.3	19.0	46.0	4.53
Quench	51.7	6.5	19.8	42.9	4.94
Guzel	55.4	6.4	19.3	50.0	4.32
Skyway	55.3	6.7	19.5	48.0	5.31
Fertilised background – N ₃₀ P ₃₀ K ₃₀					
Fandaga	57.9	7.0	20.8	47.9	5.71
Gulliver	56.6	7.3	20.4	47.9	5.70
Evgenia	64.2	7.8	22.5	50.2	6.26
Odyssey	60.0	7.9	20.9	47.0	6.73
Planet	61.0	7.9	22.4	49.1	5.81
Avalon	62.3	7.5	21.8	47.9	6.63
BARI	65.7	6.9	22.8	41.3	5.19
Fatima	59.5	7.2	19.8	48.3	6.01
Lexy	61.6	7.5	21.7	49.8	7.58
Quench	55.5	7.1	21.4	43.8	5.69
Guzel	64.4	6.7	21.2	50.7	7.19
Skyway	61.9	7.2	20.4	47.6	5.97
LSD ₀₅ :A	2.4	0.2	0.5	2.5	0.54
LSD ₀₅ : B	6.0	0.6	1.3	6.2	1.31
LSD ₀₅ : AB	8.5	0.8	1.8	8.7	1.86

Odyssey, Guzel and Lexy varieties showed the greatest response to fertilisation, providing an increase in grain yield compared to the control (without fertilisation) at the level of 2.86–3.06 t/ha or 66.2–76.1%. The smallest increase in grain yield on a fertilised background was obtained in varieties BARI (0.33 t/ha), Skyway (1.02 t/ha), Gulliver (1.06 t/ha) and Quench (1.13 t/ha).

In 2021, the highest 1000 grain weight on both backgrounds was provided by the varieties Guzel (50.2–51.9 g) and Evgenia (49.1–50.3 g), and the lowest one – by the varieties BARI weight was recorded in BARI (41.3–41.4 g) and Quench (42.9–43.8 g) varieties on both fertiliser backgrounds.

According to the correlation analysis, a moderate positive correlation was found be-

(42.3–44.8 g) and Quench (43.1–45.2 g).

In 2023, the varieties Guzel (49.4 g) and Evgenia (50.1 g) stood out by this indicator on the fertilised background, and Guzel (49.9 g), Skyway (47.8 g) and Avalon (47.2 g) varieties – on the variants without fertilisers.

Thus, the highest grain size on average for two years was observed in Guzel and Evgenia varieties, the 1000 grain weight of which was 47.1 g and 50.0 g on the background without fertiliser, respectively, and 50.7 g and 50.2 g on the fertilised background. The lowest 1000 grain weight was recorded in BARI (41.3–41.4 g) and Quench (42.9–43.8 g) varieties on both fertiliser backgrounds. The lowest 1000 grain weight and the yield ($r=0.3$ and $r=0.5$) in 2021 and 2023, respectively.

Optimal mineral nutrition is important in revealing the yield potential of malting barley varieties with the required quality indicators.

According to our data, the highest biological yields were found in the variants with a higher 1000-grain weight due to better grain filling, with relatively equal indicators for the number of stems and grain content of the spike between varieties under favourable conditions in 2021.

On the nonfertilised background, the biological yield ranged from 4.58 t/ha for Guzel to 6.17 t/ha for Avalon varieties. The introduction of $N_{30}P_{30}K_{30}$ fertiliser provided an increase in yields of the varieties from 6.65 t/ha (Fandaga) to 9.75 t/ha (Guzel). The exception was the BARI variety, the high productivity of which was formed due to higher grain content of the spike. The year 2023 was less favourable for the production process of the varieties, which was characterised by dry conditions with a water deficiency in the second half of the growing season.

Regardless of the nutritional background, the productivity level of the varieties was signi-

ficantly lower compared to 2021. Thus, on the background without fertilizers, the biological yield of the varieties ranged from 2.72 t/ha (Odyssey) to 4.77 t/ha (Skyway), and with the introduction of $N_{30}P_{30}K_{30}$ – from 3.43 t/ha (BARI) to 5.71 t/ha (Lexy). A consistently high level of yield of the Lexy variety was noted in 2021 and 2023 on a fertilised background – 9.46 t/ha and 5.71 t/ha, respectively.

On average for two years, the biological yield of varieties on the nonfertilised background ranged from 3.82 t/ha (Odyssey) to 5.31 t/ha (Skyway), and on a fertilised background – from 5.19 t/ha (BARI) to 7.58 t/ha (Lexy).

According to the comparative analysis of the averaged data of actual yields of varieties, it was found that yields ranged from 2.43 t/ha (Odyssey) to 3.06 t/ha (Lexy) on the background without fertilizers, with an average yield of 2.73 t/ha (Table 5).

Table 5. Actual yield of spring barley varieties depending on the nutrition background, t/ha, average for 2021, 2023

Variety – (factor B)	Background (factor A)		Increase in yield from fertilisers, t/ha	Average yield by backgrounds, t/ha	Effect of variety *	
	No fertilisers	$N_{30}P_{30}K_{30}$			t/ha	%
Fandaga	2.67	4.06	1.39	3.36	+0.06	+1.8
Gulliver	2.54	3.81	1.27	3.17	-0.13	-4.1
Evgenia	2.83	4.15	1.32	3.49	+0.19	+5.4
Odyssey	2.43	3.84	1.41	3.13	-0.17	-5.4
Planet	2.63	3.92	1.29	3.27	-0.03	+0.9
Avalon	2.76	3.89	1.13	3.32	+0.02	+0.6
BARI	2.86	3.84	0.98	3.35	+0.05	+1.5
Fatima	2.75	3.56	0.81	3.15	-0.15	-4.8
Lexy	3.06	4.17	1.11	3.61	+0.31	+8.6
Quench	2.69	3.79	1.10	3.25	-0.06	-1.8
Guzel	2.89	3.95	1.06	3.42	+0.12	+3.5
Skyway	2.64	3.66	1.02	3.15	-0.15	-4.8
Average yield by varieties	2.73	3.89	1.16	3.30	-	-
± effect of fertilisers	-0.57	+0.59	-	-	-	-
LSD ₀₅ , t/ha: A (background) – 0.22; B (variety) – 0.54; AB (interaction) – 0.77						

Note. * – deviations from the average yield (3.30 t/ha) by fertiliser backgrounds.

In addition to the Lexy variety, the Guzel, Evgenia and BARI varieties stood out with grain yields of 2.83–2.89 t/ha. The introduction of mineral fertilisers $N_{30}P_{30}K_{30}$ naturally provided a significant increase in grain yield of these varieties. The lowest response to fertilisation was observed in Fatima and BARI varieties with an increase in grain yield of 0.81 t/ha and

0.98 t/ha (29.5–34.3 %), and the highest one – in Odyssey and Fandaga varieties – 1.41 t/ha (58.0 %) and 1.39 t/ha (52.1 %), respectively, with an average yield of 3.89 t/ha. The maximum grain yield on the fertilised background was provided by Lexy, Evgenia and Fandaga varieties – 4.17, 4.15 and 4.06 t/ha, respectively. The average yield of barley varieties was

3.30 t/ha, ranging from 3.13 to 3.61 t/ha. At the same time, on average on both backgrounds, the highest yields were obtained by Lexy, Evgenia and Guzel varieties – 3.61 t/ha, 3.49 and 3.42 t/ha, respectively, which is 3.5–8.6 % higher than the average for the experiment.

When determining the effect of genotype, it was found that the highest positive values were observed for the varieties Lexy (+0.31 t/ha), Evgenia (+0.19 t/ha) and Guzel (+0.12 t/ha) with an average yield of 3.30 t/ha. Fandaga (+0.06 t/ha), BARI (+0.05 t/ha) and Avalon (+0.02 t/ha) varieties had a less significant but positive effect. The most negative values of this indicator were observed in the varieties Odyssey (-0.17 t/ha), Skyway (-0.15 t/ha), Fatima (-0.15 t/ha) and Gulliver (-0.13 t/ha).

Thus, the varieties Lexy, Evgenia and Guzel were the most adapted to the growing conditions, as they had the best indicators of grain productivity, the highest yield and the most pronounced positive response to the fertilised background.

Conclusions. The maximum number of productive stems on a nonfertilised background was formed by Skyway and Quench varieties (560–580 pcs/m²), and when applying N₃₀P₃₀K₃₀ – Odyssey, Guzel and Lexy varieties (680–690 pcs/m²) with a productive tillering

coefficient of 1.8–2.0 productive stems per plant, respectively. On both backgrounds, the largest number of grains per spike (from 20.0 to 22.8) was formed by BARI, Evgenia and Planet varieties. The highest 1000-grain weight was observed in Guzel and Evgenia varieties, which was 47.1–50.0 g in the variant without fertiliser, and 50.2–50.7 g in the variant with N₃₀P₃₀K₃₀. The biological yield of the varieties on the non-fertilised background was 3.82–5.31 t/ha, and on the fertilised background – 5.19–7.58 t/ha. Odyssey, Guzel and Lexy varieties had the highest response to fertilisation with an increase in grain yield of 2.86–3.06 t/ha or 66.2–76.1 %. The highest actual yields (2.83–3.06 t/ha) were obtained on the background without fertilisers in Lexy, Guzel, Evgenia and BARI varieties. With the introduction of N₃₀P₃₀K₃₀, the maximum increase in grain was provided by Odyssey (1.41 t/ha) and Fandaga (1.39 t/ha). The greatest effect of the variety on the average yield by variety (3.30 t/ha) was observed in Lexy (+0.31 t/ha), with a grain yield increase of 8.6 %. The varieties Lexy, Evgenia and Guzel can be considered the most suitable for the eastern part of the Forest-Steppe of Ukraine, since in both years of cultivation these varieties provided the highest yields and had the most pronounced positive response to the nutrition background.

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Попов С. І., Кузьменко Н. В., Гутянський Р. А., Глубокий О. М., Міхальов І. А. Морфологічні особливості та урожайність сортів ячменю ярого пивоварного напрямку використання залежно від умов вирощування. Зернові культури. 2024. 8 (2). 226–234.

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Актуальність. Підвищення попиту на пивоварний ячмінь спонукає селекціонерів до створення нових сортів, що поєднують високий рівень урожайності та якості зерна зі стійкістю до несприятливих умов середовища. Вагоме значення на сьогодні має впровадження у виробництво технологій вирощування високоадаптивних сортів ячменю ярого як вітчизняної, так зарубіжної селекції, здатних підвищити реалізацію їхнього потенціалу продуктивності та стабільності зерновиробництва. **Мета досліджень** – вивчити особливості формування морфологічних ознак, елементів продуктивності та урожайності пивоварних сортів ячменю ярого зарубіжної селекції залежно від фону живлення та погодних умов року. **Матеріали та методи.** Досліди закладали на двох фонах живлення: 1 – без добрив; 2 – внесення $N_{30}P_{30}K_{30}$. Вивчали 12 зарубіжних сортів пивоварного напрямку використання. Використовували лабораторні, польові, розрахункові та статистичні методи. **Результати.** Встановлено, що на ріст, розвиток і формування елементів продуктивності пивоварних сортів ячменю ярого суттєво впливали погодні умови вегетаційного періоду та фон живлення. У середньому за 2021 та 2023 рр., на фоні без добрив найбільшу кількість продуктивних стебел сформували сорти *Skyway* і *Queen* ($560\text{--}580$ шт./ m^2), а на удобреному – сорти *Odyssey*, *Guzel* і *Lexu* ($680\text{--}690$ шт./ m^2) з показниками продуктивної куцистості відповідно 1,9, 2,0 та 1,8. Найбільшу кількість зерен у колосі на обох фонах забезпечили сорти *BARI*, *Evgenia* та *Planet* – від 20,0 до 22,8 шт. Найвищу масу 1000 зерен мали сорти *Guzel* та *Evgenia*, яка на фоні без добрив становила 47,1–50,0 г, а на удобреному – 50,2–50,7 г. Найбільшу реакцію на внесення добрив відмічено у сортів *Odyssey*, *Guzel* і *Lexu*, які, за даними біологічної врожайності, забезпечили приріст зерна 66,2–76,1 %. Фактична врожайність на фоні без добрив була в межах від 2,43 т/га (*Odyssey*) до 3,06 т/га (*Lexu*), за середньої врожайності сортів 2,73 т/га. При цьому виділялись сорти *Lexu*, *Guzel*, *Evgenia* та *BARI* з рівнем урожайності 2,83–3,06 т/га. На фоні внесення $N_{30}P_{30}K_{30}$ максимальну надбавку зерна до контролю забезпечили сорти *Odyssey* (1,41 т/га) і *Fandaga* (1,39 т/га). Найбільший ефект сорту до середньої врожайності по сортах (3,30 т/га) відмічено у *Lexu* (+0,31 т/га), при цьому надбавка зерна становила 8,6 %. **Висновки.** Сорти *Lexu*, *Evgenia* та *Guzel* можна вважати найбільш придатними для східної частини Лісостепу України, оскільки, незалежно від умов вирощування в роки дослідження, вони формували найвищу зернову продуктивність і мали найбільш виражену позитивну реакцію на добрива.

Ключові слова: ячмінь ярий, пивоварні сорти, добрива, показники структури врожайності, продуктивність, урожайність