

Article

Biometric Indicators of Variety Samples of Porey Onions

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Abstract: The article presents the results of a study of the biometric indicators of leek variety samples and their significance for evaluating valuable morphological and economically important traits. The study was conducted during 2022–2024 using established methodological guidelines for ecological and variety testing of vegetable crops, with statistical analysis performed using analysis of variance. The biometric characteristics assessed included the number of leaves per plant, leaf length and width, leaf area per leaf, total leaf area per plant and per unit of field area, plant height, and pseudostem length and diameter. The results demonstrated considerable variation among the studied variety samples. The highest number of leaves, 13 per plant, was recorded in BIN 20, UGH 223, and K-104. The largest individual leaf areas were observed in Bandit (394.7 cm²), UGH 223 (371.6 cm²), BIN 20 (360.2 cm²), and K-104 (351.5 cm²), while UGH 223, Bandit, BIN 20, and K-104 also demonstrated the highest total leaf area per plant and per unit of field area. Significant differences were also identified in plant height and pseudostem characteristics, with BIN 20 showing the greatest plant height (101.8 cm), while BIN 20, UGH 223, and K-104 had the longest pseudostems. The findings indicate that the studied variety samples possess distinct combinations of biometric traits, reflecting differences in their vegetative growth and morphological development. In particular, the greater leaf area and pseudostem dimensions observed in several samples indicate their potential value for further breeding and variety evaluation. Overall, the obtained results provide useful comparative information for identifying promising leek genotypes and selecting plant materials with desirable biometric characteristics for future breeding and production studies.

Keywords: leaf number, leaf length, leaf width, single leaf surface, leaf surface on one Bush, fertile, false stem, false stem length, false stem diameter, false stem crop.

Introduction

Leek leaves develop from the central growth point and grow upward through tubular leaf bases. Arranged in a fan-like pattern, their tight overlapping creates a light green pseudostem. The pseudostem is one of the key morphological and economically important traits of the leek. Its length

depends on the characteristics of the variety, typically ranging from 10 to 80 cm, with a thickness of around 4–7 cm. The leaf blades are covered with a waxy coating of varying density, which protects the plant from transpiration and increases its resistance to environmental stress.

The pseudostem is formed as the lower parts of the leaves adhere tightly to one another. The pseudostem length varies depending on the variety: 10–25 cm in short-pseudostem varieties, 25–45 cm in medium- and long-pseudostem varieties, and up to 60–80 cm in varieties adapted to southern climatic conditions. In some cases, the pseudostem diameter reaches up to 9 cm. The pseudostem is usually light green, and in most leek varieties, its lower part terminates in a slightly thickened bulbous base. This structure determines the biological characteristics and economic value of the plant [1]; [2]; [3] [4].

Under specific environmental conditions, particularly under a very long photoperiod and a temperature regime averaging 5–18°C, the formation of small bulbs (bulbous swellings) may be observed in leeks. This phenomenon manifests as a physiological response of the plant to environmental factors. Furthermore, similar to common onions, a sharp decline in growth rate is recorded in leeks after reaching the stage of technical maturity. That is, after this phase, the vegetative development of the plant slows down, and biomass accumulation virtually ceases. This characteristic is an important indicator representing the biological development patterns of the leek [5].

In its second year of life, the leek transitions to the generative development stage and forms a flowering stalk (generative stem). Located at the base of the pseudostem, this stem has a smooth and rounded appearance. As the pseudostem grows, the generative stem also gradually develops, reaching a diameter of approximately 2–3 cm and a height of up to 2 m. During the plant's second year, branching at the lower part of the stem intensifies, forming lateral branches and large buds. Subsequently, as the biological development process continues, the lower part of the stem gradually ages and dies off by the third year.[6][7]

In true leeks, a bulb-like structure (a partially thickened base) is formed, at the bottom of which 1–2 growth points (meristems) are typically located. This part is covered with 1–2 layers of thick, closed protective scales. According to researchers G. Kruga and Yu.I. Soldatov, when the seed-producing stem is damaged or the plant faces adverse environmental conditions such as drought, several small, silvery-white bulbs (usually 3–8)—known as "pearl bulbs"—may form. When these vegetative propagation organs are planted in the ground, they develop into vegetative plants characteristic of the first year of the leek's life cycle, thereby ensuring the plant's regeneration [8]

Materials and Methods

Field experiments were conducted using guidelines such as "Methodological Instructions for Ecological Testing of Vegetable Crops in Open Ground" (Moscow, 1981), "Methodology of Experimental Work in Vegetable and Melon Growing" (Moscow, 1992), "Methodology of Conducting Experiments on Vegetable, Melon, and Potato Crops" (Tashkent, 2023), and "Methodology of State Variety Testing of Agricultural Crops" (Moscow, 2015). Statistical analysis of the data was carried out using Microsoft Excel based on B.A. Dospekhov's analysis of variance (ANOVA) method.[9][10]

Results

When the number of leaves formed per plant was analyzed in the studied leek cultivar accessions, the highest number of leaves was recorded in the BIN 20, UGH 223, and K-104 accessions, with 13 leaves formed per plant. In the Mamont, Bandit, Goliaf, Merlin (st), BGSN 62, and Forrest accessions, this indicator was 12 leaves per plant, while in the Tango, Alligator, and Russkiy razmer accessions, it was 11 leaves per plant. The lowest number of leaves was observed in the Xobot slona accession, where 10 leaves were formed per plant.[11]

Analysis of leaf length in the leek cultivar accessions showed that the average leaf length in the standard Merlin (st) accession was 70.7 cm. Compared with the standard, the Forrest accession had a leaf length of 82.5 cm, which was 11.8 cm longer; the Russkiy razmer accession had a leaf length of 79.5 cm, which was 8.8 cm longer; the Bandit accession had a leaf length of 75.9 cm, which was 5.2 cm longer; and the Alligator accession had a leaf length of 73.4 cm, which was 2.7 cm longer.[12][13]

In addition, compared with the Merlin (st) accession, shorter leaves were recorded in the BGSN 62 accession, with a leaf length of 69.3 cm, which was 1.4 cm shorter; in the K-104 accession, with 67.6 cm, which was 3.1 cm shorter; in the BIN 20 accession, with 66.7 cm, which was 4.0 cm shorter; and in the UGH 223 accession, with 65.2 cm, which was 5.5 cm shorter.

Conversely, the shortest leaves were observed in the Tango (58.7 cm) and Mamont (57.6 cm) accessions, which were 12.0 cm and 13.1 cm shorter, respectively, than those of the standard Merlin (st) accession.

When the experimental data obtained for leaf length in the leek cultivar accessions were subjected to mathematical and statistical analysis, the least significant difference $EKMF_{05}$ was found to be 2.05 cm, while the coefficient of variation was $Sx\% = 2.93\%$.

Analysis of leaf width in the studied leek cultivar accessions showed that the leaf width of the standard Merlin (st) accession was 4.8 cm. Compared with the standard, wider leaves were formed in the UGH 223 accession, with a leaf width of 5.7 cm, which was 0.9 cm wider; in the BIN 20 accession, with 5.4 cm, which was 0.6 cm wider; and in the Bandit and K-104 accessions, with 5.2 cm, which was 0.4 cm wider.

At the same time, compared with the Merlin (st) accession, narrower leaves were observed in the Mamont accession, with a leaf width of 4.2 cm, which was 0.6 cm narrower; in the Forrest and Goliaf accessions, with 3.9 cm, which was 0.9 cm narrower; in the Tango accession, with 3.7 cm, which was 1.1 cm narrower; in the BGSN 62 accession, with 3.6 cm, which was 1.2 cm narrower; in the Xobot slona accession, with 3.1 cm, which was 1.7 cm narrower; and in the Russkiy razmer accession, with 3.5 cm, which was 1.3 cm narrower.[14]

Table 1. Leaf size of leek cultivar samples (2022-2024)

Sample name	Number of leaves per bush, pcs.	Leaf size (length × width) cm	Leaf level		
			One piece, cm ²	In one bush, cm ²	In one hectare, thousand m ²
Merlin (st) (Netherlands)	12	70,7×4,8	339,4±8,1	4072,3±96,9	77,6±1,1
Forrest (Netherlands)	12	82,5×3,9	321,8±7,7	3861,0±91,9	73,5±1,5
K-104 (Russia)	13	67,6×5,2	351,5±8,4	4569,8±108,8	87,0±1,8
Russkiy Razmer (Russia)	11	79,5×3,5	278,3±5,7	3060,8±62,5	58,3±1,2
BGSN 62 (Russia)	12	69,3×3,6	249,5±4,6	2993,8±54,7	57,0±0,8
Khobot Slona (Russia)	10	70,6×3,1	218,9±4,0	2188,6±40,0	41,7±0,6
UGH 223 (Russia)	13	65,2×5,7	371,6±7,6	4831,3±98,6	92,0±1,4
Alligator (Russia)	11	73,4×4,7	345,0±7,0	3794,8±77,5	72,3±1,1
BIN 20 (Russia)	13	66,7×5,4	360,2±6,6	4682,3±85,5	89,2±1,3
Tango (Russia)	11	58,7×3,7	217,2±4,0	2389,1±43,6	45,5±0,7
Mamont (Russia)	12	57,6×4,2	241,9±4,9	2903,0±59,3	55,3±0,8
Bandit (Netherlands)	12	75,9×5,2	394,7±8,1	4736,2±96,7	90,2±1,3
Goliaf (Netherlands)	12	71,1×3,9	277,3±6,6	3327,5±79,2	63,4±0,9
$EKMF_{05}$	0,34	2,05	8,8	105,7	2,01
$Sx\%$	2,91	2,93	2,89	2,90	2,90

According to the data presented in Table 1, the leaf area per leaf in the standard Merlin (st) cultivar accession was 339.4 cm². Compared with this value, the leaf area per leaf in the Bandit (394.7 cm²), UGH 223 (371.6 cm²), BIN 20 (360.2 cm²), K-104 (351.5 cm²), and Alligator (345.0 cm²) cultivar accessions was found to be higher by 16.3–1.6%, or by 55.3–5.6 cm², respectively.

In contrast, in the Forrest (321.8 cm²), Goliaf (277.3 cm²), BGSN 62 (249.5 cm²), Mamont (241.9 cm²), Xobot slona (218.9 cm²), Tango (217.2 cm²), and Russkiy razmer (278.3 cm²) cultivar accessions,

the leaf area per leaf was recorded as lower than that of the standard by 17.6–122.2 cm². When the data obtained for leaf area per leaf were subjected to mathematical and statistical analysis, the least significant difference $EKMF_{05}$ was 8.8 cm², while the coefficient of variation was $Sx\% = 2.89\%$.

When the total leaf area per plant was determined in the studied leek cultivar accessions, compared with the standard Merlin (st) cultivar (4072.3 cm²), the UGH 223 (4831.3 cm²), Bandit (4736.2 cm²), BIN 20 (4682.3 cm²), and K-104 (4569.8 cm²) accessions were found to have greater total leaf areas per plant by 759.0–497.5 cm², respectively.

At the same time, in the Russkiy razmer accession (3060.8 cm²), as well as in the BGSN 62 (2993.8 cm²), Mamont (2903.0 cm²), Tango (2389.1 cm²), and Xobot slona (2188.6 cm²) accessions, the total leaf area per plant was recorded as lower than that of the standard by 1011.5–1883.7 cm². Mathematical and statistical analysis of the data obtained for total leaf area per plant showed that the least significant difference $EKMF_{05}$ was 105.7 cm², while the coefficient of variation was $Sx\% = 2.90\%$.

Furthermore, analysis of leaf area per unit of field area showed that this indicator was 77.6 thousand m² in the standard Merlin (st) cultivar accession. Compared with the standard, the leaf area per unit of field area in the UGH 223 (92.0 thousand m²), Bandit (90.2 thousand m²), BIN 20 (89.2 thousand m²), and K-104 (87.0 thousand m²) accessions was higher by 14.4, 12.6, 11.6, and 9.4 thousand m², respectively.[15]

However, in the Forrest (73.5 thousand m²) and Alligator (72.3 thousand m²) cultivar accessions, the leaf area per unit of field area was lower than that of the standard by 4.1–5.3 thousand m². In the Goliaf (63.4 thousand m²), BGSN 62 (57.0 thousand m²), and Russkiy razmer (58.3 thousand m²) accessions, this indicator was lower by 14.2–20.6 thousand m², while in the Mamont (55.3 thousand m²), Tango (45.5 thousand m²), and Xobot slona (41.7 thousand m²) accessions, it was lower by 22.3–35.9 thousand m².

When the data obtained for leaf area per hectare were subjected to mathematical and statistical analysis, the least significant difference $EKMF_{05}$ was 2.01 thousand m², while the coefficient of variation was $Sx\% = 2.90\%$.

Table 2. Porey onion variety specimen plants have a height of and false stem sizes of (2022-2024 yy.)

Nav sample name	Plant height, cm	False stem	
		uzunligi, sm	diameter, CM
Merlin (st) (Netherlands)	91,1±1,37	20,3±0,29	3,6±0,05
Forrest (Netherlands)	99,1±1,93	16,6±0,32	3,3±0,06
K-104 (Russia)	96,2±1,46	28,6±0,44	4,8±0,07
Russkiy Razmer (Russia)	98,7±1,42	19,2±0,28	3,8±0,06
BGSN 62 (Russia)	88,8±1,21	19,5±0,27	3,8±0,05
Khobot Slona (Russia)	95,9±1,60	25,3±0,43	3,2±0,05
UGH 223 (Russia)	90,6±1,84	32,1±0,65	5,4±0,11
Alligator (Russia)	92,9±1,88	19,6±0,40	2,9±0,06
BIN 20 (Russia)	101,8±1,77	35,1±0,61	4,1±0,07
Tango (Russia)	84,4±1,50	25,7±0,45	3,9±0,07
Mamont (Russia)	82,4±1,14	24,8±0,36	3,2±0,04
Bandit (Netherlands)	99,1±1,43	23,1±0,32	3,0±0,04
Goliaf (Netherlands)	99,1±1,23	27,9±0,35	2,2±0,03
$EKMF_{05}$	2,72	0,73	0,11
$Sx\%$	2,90	2,98	3,03

According to the results of biometric measurements conducted on plant height and pseudostem dimensions of the studied leek cultivar accessions, the plant height of the standard Merlin (st) cultivar accession was 91.1 cm. Compared with this value, the plant height was found to be greater by 10.7–1.8 cm in the BIN 20 (101.8 cm), Bandit (99.1 cm), Goliaf (99.1 cm), Forrest (99.1 cm), Russkiy razmer (98.7 cm), K-104 (96.2 cm), Xobot slona (95.9 cm), and Alligator (92.9 cm) accessions.

In addition, compared with the standard Merlin (st) cultivar, the plant height in the UGH 223 (90.6 cm), BGSN 62 (88.8 cm), Tango (84.4 cm), and Mamont (82.4 cm) accessions was lower by 0.5–8.7 cm, respectively. Mathematical and statistical analysis of the data obtained for plant height showed that the least significant difference $EKMF_{05}$ was 2.72 cm, while the coefficient of variation was $Sx\% = 2.90\%$.

The pseudostem length of the standard Merlin (st) leek cultivar accession was found to be 20.3 cm. Compared with this value, the pseudostem length was greater by 14.8–8.3 cm in the BIN 20 (35.1 cm), UGH 223 (32.1 cm), and K-104 (28.6 cm) accessions, respectively. Likewise, the pseudostem length in the Goliaf (27.9 cm), Tango (25.7 cm), Xobot slona (25.3 cm), Mamont (24.8 cm), and Bandit (23.1 cm) accessions was greater than that of the standard by 7.6–2.8 cm.

In contrast, the pseudostem length in the Alligator (19.6 cm), BGSN 62 (19.5 cm), Russkiy razmer (19.2 cm), and Forrest (16.6 cm) accessions was shorter than that of the Merlin (st) cultivar by 0.7–3.7 cm. Mathematical and statistical analysis of pseudostem length in the leek cultivar accessions showed that the least significant difference $EKMF_{05}$ was 0.73 cm, while the coefficient of variation was $Sx\% = 2.98\%$.

Based on pseudostem thickness, the studied leek cultivar accessions were divided into the following groups:

Very thick pseudostems (more than 4.0 cm): UGH 223 (5.4 cm), K-104 (4.8 cm), and BIN 20 (4.1 cm);

Thick pseudostems (3.1–4.0 cm): Tango (3.9 cm), BGSN 62 (3.8 cm), Russkiy razmer (3.8 cm), Forrest (3.3 cm), Mamont (3.2 cm), and Xobot slona (3.2 cm);

Medium-thick pseudostems (2.1–3.0 cm): Bandit (3.0 cm), Alligator (2.9 cm), and Goliaf (2.2 cm).

The pseudostem diameter of the standard Merlin (st) cultivar accession was 3.6 cm. Compared with the standard, the pseudostem diameter in the UGH 223 (5.4 cm) and K-104 (4.8 cm) accessions was greater by 1.8 and 1.2 cm, respectively. Similarly, in the BIN 20 (4.1 cm), Tango (3.9 cm), BGSN 62 (3.8 cm), and Russkiy razmer (3.8 cm) accessions, this indicator was greater by 0.5–0.2 cm.

In contrast, the pseudostem diameter in the Forrest (3.3 cm), Mamont (3.2 cm), Xobot slona (3.2 cm), Bandit (3.0 cm), Alligator (2.9 cm), and Goliaf (2.2 cm) accessions was smaller than that of the standard Merlin (st) cultivar by 0.3, 0.4, 0.4, 0.6, 0.7, and 1.4 cm, respectively. Mathematical and statistical analysis of pseudostem diameter showed that the least significant difference $EKMF_{05}$ was 0.11 cm, while the coefficient of variation was $Sx\% = 3.03\%$.

Conclusions

Leaf length and width: The largest leaf dimensions were recorded in the Forrest (82.5 × 3.9 cm), Bandit (75.9 × 5.2 cm), Alligator (73.4 × 4.7 cm), and Russkiy razmer (79.5 × 3.5 cm) cultivars. The smallest leaves were characteristic of the Tango (58.7 × 3.7 cm) and Mamont (57.6 × 4.2 cm) cultivars.

Leaf area per leaf: The largest leaf areas were observed in the Bandit (394.7 cm²), UGH 223 (371.6 cm²), BIN 20 (360.2 cm²), K-104 (351.5 cm²), and Alligator (345.0 cm²) cultivars. The smallest leaf areas were recorded in the Forrest (321.8 cm²), Goliaf (277.3 cm²), BGSN 62 (249.5 cm²), Mamont (241.9 cm²), Xobot slona (218.9 cm²), Tango (217.2 cm²), and Russkiy razmer (278.3 cm²) cultivars.

Total leaf area per plant: The largest total leaf area per plant was recorded in the UGH 223 (4831.3 cm²), Bandit (4736.2 cm²), BIN 20 (4682.3 cm²), and K-104 (4569.8 cm²) cultivars. The smallest total leaf area per plant was characteristic of the Russkiy razmer (3060.8 cm²), BGSN 62 (2993.8 cm²), Mamont (2903.0 cm²), Tango (2389.1 cm²), and Xobot slona (2188.6 cm²) cultivars.

Leaf area per unit of field area: The highest leaf area per unit of field area was recorded in the UGH 223 (92.0 thousand m²), Bandit (90.2 thousand m²), BIN 20 (89.2 thousand m²), and K-104 (87.0 thousand m²) cultivars. The lowest leaf area per unit of field area was observed in the Mamont (55.3 thousand m²), Tango (45.5 thousand m²), and Xobot slona (41.7 thousand m²) cultivars.

Plant height: The tallest plants were characteristic of the BIN 20 (101.8 cm), Bandit (99.1 cm), Goliaf (99.1 cm), Forrest (99.1 cm), Russkiy razmer (98.7 cm), K-104 (96.2 cm), and Xobot slona (95.9 cm) cultivars. The lowest plant height was observed in the Tango (84.4 cm) and Mamont (82.4 cm) cultivars.

Pseudostem length: The longest pseudostems were recorded in the BIN 20 (35.1 cm), UGH 223

(32.1 cm), and K-104 (28.6 cm) cultivars. Shorter pseudostems were observed in the Alligator (19.6 cm), BGSN 62 (19.5 cm), Russkiy razmer (19.2 cm), and Forrest (16.6 cm) cultivars.

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