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BREEDING VALUE OF SHALLOT CULTIVARS AND LOCAL FORMS IN TERMS OF ECONOMIC CHARACTERS FOR THE RIGHT-BANK FOREST-STEPPE OF UKRAINE

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Purpose. To indentify the best shallot cultivars and local forms by growing period length, bulb yield, leaf productivity, and bulb weight and number per clump in the Right-Bank Forest-Steppe of Ukraine. **Methods.** Statistical processing, field assessments, computational and analytical methods. **Results.** Collection shallot accessions were evaluated for growing period lengthand, bulb weight, number and performance. Early-ripening accession 'Sh-8' with a vegetation period of 74 days was selected. Local form 'Sh-1' from the Kyivska Oblast region turned out to be the best in terms of the mean bulb weight per clump (26.7 g). Accessions from Kyivska ('Sh-1', 'Sh-2'), Dnipropetrovska ('Sh-6', 'Sh-9'), and Chernihivska ('Sh-10') Oblasts yielded the most (30.5, 25.4, 18.9, 18.1, and 19.4 t/ha, respectively). The check cultivar, 'Lira', yielded 15.5 t/ha. The smallest yields were harvested from the following accessions: 'Sh-4' (12.2 t/ha), 'Sh-7' (12.0 t/ha), 'Sh-11' (11.9 t/ha), 'Sh-12' (13.8 t/ha ha), 'Sh-13 (13.2 t/ha), and 'Sh-14' (13.0 t/ha). Two accessions, which came from the Kyivska ('Sh-3)' and Dnipropetrovska ('Sh-6') Oblasts were found to be best adapted to the environmental conditions of the Right-Bank Forest-Steppe of Ukraine. Their Lewis's phenotypic stability factors were close to 1. A local form from the Dnipropetrovska Oblast, 'Sh 9' was the worst adapted accessions, as its Lewis's phenotypic stability factor was as high as 1.2. The maximum leaf length was recorded for accessions from the Kyivska ('Sh-1', 'Sh-2'; 38.0 and 35.8 cm, respectively) and Chernihivska ('Sh-10'; 36.2 cm) Oblasts. **Conclusions.** Due to this study, shallot accessions with short growing periods, great weights and numbers of bulbs and yield were selected for the conditions in the Right-Bank Forest-Steppe of Ukraine. 'Sh-1' sample originating from the Kyivska Oblast showed the best results in terms of the bulb weight (26.7 g) and yield (30.5 t/ha). However, it turned out to be late-ripening (86 days), and only formed on average 4 bulbs per clump. The maximum leaf length was 38 cm was. 'Sh-8', a local form from the Dnipropetrovska Oblast, was the most early-ripening (74 days).

Key words: shallots, yield, growing period, cultivars, local forms, bulb weight, leaf traits.

Introduction. Shallot (*Allium sera var. aggregatum* G.Don.) is a vegetable that is commonly grown in tropical countries, including Indonesia, and used as a spice for daily cooking, medicine, cosmetics, and dietary supplements (*Stanley J. Kays, 2011*). It is a valuable and indispensable consumer product in Indonesia, which is confirmed by annually increasing product consumption and price fluctuations (*Herlina L. et al., 2019*). Shallot production reaches 7.21% of the total vegetable production in Indonesia and ranks third after cabbages and potatoes (*Rahmawati A. et al., 2018, Arifin B. et al., 2019*). Its pungent aroma and unique palatability are indispensable for cooking (*Tabor G., 2018*). Shallots are used to treat some diseases in folk medicine, as the plant contains antiseptic compounds with antimicrobial activities (*Askari-Khorasgani & Pessarakli M., 2019; Wulaisfan R., Musdalipah, & Nurhadiah, 2018*). The first positions in the annual production of bulbs are occupied by China and Japan - more than 500,000 tons, followed by New Zealand, Mexico, Iran, Iraq, Cambodia and Cameroon (*FAOSTAT, 2018*).

Recently, the demand for shallots in the globalproduction has risen significantly, resulting in intensification of the breeding of this crop, which requires searching for and studying local forms that are widespread in Ukraine (*Korniienko S. I. et al., 2013; Bilenka O. M., 2015; Bilenka O.M., 2018*). Creation of new cultivars is a long and expensive process. However, screening of existing local forms for adaptation to production in certain environmental conditions and their use as starting materials in breeding can accelerate this process. Development and evaluation of available shallot cultivars is a sustainable strategy to boost performance and production. Tolerant local forms is one of the most effective and inexpensive options.

Review of Recent Studies and Publications. Shallot is a close relative of onion. Shallot, despite

some differences in anthesis time, easily crosses with onion and gives fertile offspring, and these two varieties show a strong cytological and morphological similarity (*Rabinowitch & Kamenetsky, 2002*).

Since shallot reproduce itself mainly vegetatively, pathogens (fungi, bacteria and viruses) are accumulated in bulbs, worsening performance and quality. Use of bulbs as planting material poses several problems: a large amount (1.2 t/ha) of bulbs is required, which is expensive and requires long storage with significant post-harvest losses. Bulbs also pass fungal diseases, such as *Fusarium* spp., and latent viruses (*SLV*) from generation to generation (*Kotlinska T., 1995*). Great damage is caused by sucking pests (nematodes, thrips, mites, and onion sucker), which overwinter between dry and juicy scales during storage, and move to leaves in spring. They, in addition to direct damage to plants, are vectors of many viral and bacterial diseases.

In Ukraine, local forms and cultivars do not yield much (0.5–1.4 kg/m^2), with the mean bulb weight per clump of 7.9–18.3 g and bulb number per clump of 4.4–7.4 (*Bilenka O. M., 2018*). Strong branching of shallot plants makes it possible to obtain a clump containing 4-10 bulbs of different sizes from one planted bulb, allowing for simultaneous segregation of large (commercial) and small (intended for planting) bulbs. Each bulb, after rooting and growing, forms up to 10 shoots, which bear 5-7 leaves in compacted tufts. The length of the maximally developed leaf is 25–54 cm, and the plant weight in the technical ripeness phase is 53–85 g. Green shallot leaves are rich in total sugar (4–5%), at the level of perennial onion species (*Kovalenko Ye., 2005; Bilenka O. M., 2018*).

Farmers consider several factors, including production potential, market demand, environmental adaptability, seed availability, and price, when they select cultivars for planting (*Sych Z.D. & Kubrak S.M., 2023*).

Shallot cultivars and local forms grown in Ukraine have not yet been enough studied regarding their response to environmental factors. At the same time, they occupy an important position in production and home gardening. Shallots can be grown for bulbs and leek forcing both outdoors and indoors. Shallot is a multigerm plant; hence, it is most suitable for leek growing (*Sych, Z.D. & Kovalenko Ye. M., 2007*).

Shallot is a crop that is propagated mainly vegetatively, but foreign breeders have already created cultivars and hybrids that are also suitable for generative reproduction in industrial conditions *(Aklilu S., 2014*).

Onion business is considered profitable and has been quite popular recently. Some farmers continue to grow local forms, which they bred themselves, as such forms are well adapted to regional conditions. There are few high-yielding cultivars suitable for dissemination in Ukraine in the State Register (*Melnyk S.I., 2019; Melnyk S.I., 2020; Hriunvald N.V., 2021; Hriunvald N.V., 2022*). Foe example, 3 and 4 cultivars were included in the State Register in 2022 and 2021, respectively.

Cultivation of shallots obtained from another region, without proper growing of planting material and rehabilitation, leads to rapid degeneration and decreased yields after 2-3 generations. Therefore, the problem of selecting the best shallot cultivars by growing season length, the number and weight of underground bulbs, leaf productivity, resistance to diseases and pests, and yield requires constant investigation.

Our **purpose** was to indentify the best shallot cultivars and local forms by growing period length, bulb yield, leaf traits, and bulb weight and number per clump in the Right-Bank Forest-Steppe of Ukraine.

Materials and Methods. The study was conducted in the Right-Bank Forest-Steppe of Ukraine, in an experimental field of Bela Tserkva National University, in 2019–2020. The shallot collection comprised 30 cultivars and local forms from different regions of Ukraine: Kyivska, Dnipropetrovska, Kirovohradska, Chernihivska, and Cherkaska Oblasts. The accessions were evaluated in compliance with "Experimantation Methods in Vegetable and Melon Growing" (*Yakovenko K. I. (Eds., 2001*). Cultivar ‘Lira’ bred by the Institute of Vegetable and Melon Growing of NAAS was used as a control. The soil in the experimental site is typical low-humus mid-loamy chernozem. No irrigation was used. Cultivation was carried out by conventional technology (*Bondarenko H.L. & Yakovenko K.I., 2001*). Shallot cultivars were planted by tape method according to a 50+20+20x10 cm design (the density was 286,000 plants/ha). The record plot was 3 m^2. Bulb harvest was started when signs of leaf drying appeared in the first half of July ("Distinction, Uniformity and Stability Tests on Vegetable, Potato and Mushroom Cultivars", 2021).

Shallot bulbs were stored in boxes, packed in layers of 5–12 cm thick, by cold-warm method under uncontrolled conditions (in spring and autumn at 18–20 °C, in winter at around 0°C) from August to March (inclusive).

Lewis’s phenotypic stability factor (SF) was calculated using the following formula: SF = HE / LE, where HE and LE - high and low yields in different

years, respectively (*Yakovenko K. I. (Eds), 2001*). Its closeness to 1 indicated high stability, and moving away from 1, on the contrary, meant instability. Data were statistically processed by analysis of variance in Statistica 7 (*Sych Z.D., 1993*).

Results. The study showed that, in 2019, accession 'Sh-1', which came from the Kyivska Oblast, had the longest growing period (as long as 85 days) (Table 1). The shortest period of 73 days was recorded for the control shallot cultivar, 'Lira'. The growing periods in 'Sh-7', 'Sh-8' (Dnipropetrovska Oblast; 74 and 73 days, respectively), 'Sh-11', and 'Sh-12' (Chernihivska Oblast; 75 days each), 'Sh-13', 'Sh-14' (Cherkaska Oblast; 75 days each).

In 2020, the growing season of different local shallot forms ranged from 74 days ('Sh-8') to 86 days ('Sh-1'). In the control cultivar, 'Lira', it was 75 days. The growing periods were one to two days longer than that in 'Lira' in the following accessions: 'Sh-4', 'Sh-7', 'Sh-14' (77 days), 'Sh-11', 'Sh-12', and 'Sh-13' (76 days). However, the growing periods of 'Sh-2', 'Sh-6', 'Sh-9', and 'Ш-10' were 5-7 days longer than that in 'Lira'.

Table 1. Growing periods of shallot cultivars and local forms

Accession	Origin	Growing period, days		
		2019	2020	Mean for 2019-2020
Lira (control cultivar)	Kharkivska Oblast, UKR	73	75	74
Sh-1	Kyivska Oblast, UKR	85	86	86
Sh-2	Kyivska Oblast, UKR	79	82	81
Sh-3	Kyivska Oblast, UKR	77	79	78
Sh-4	Kyivska Oblast, UKR	76	77	77
Sh-5	Kyivska Oblast, UKR	75	78	77
Sh-6	Dnipropetrovska Oblast, UKR	78	80	79
Sh-7	Dnipropetrovska Oblast, UKR	74	77	76
Sh-8	Dnipropetrovska Oblast, UKR	73	74	74
Sh-9	Dnipropetrovska Oblast, UKR	79	81	80
Sh-10	Chernihivska Oblast, UKR	79	82	81
Sh-11	Chernihivska Oblast, UKR	75	76	76
Sh-12	Chernihivska Oblast, UKR	75	76	76
Sh-13	Cherkaska Oblast, UKR	75	76	76
Sh-14	Cherkaska Oblast, UKR	75	77	76
LSD 05				1.3

Of the shallot cultivars under investigation on average for 2019-2020, the earliest ripening of bulbs was observed in 'Sh-8', which was delivered from the Dnipropetrovska Oblast. Its growing period was the same as that of 'Lira' (74 days). Bulbs ripened one or two days later in 'Sh-4', 'Sh-5', 'Sh-7', 'Sh-11', 'Sh-12', 'Sh-1'3, and 'Sh-14'. 'Sh-2', 'Sh-6', 'Sh-9', 'Sh-10' had intermediate duration. Their growing periods lasted 81, 79, 80, and 81 days, respectively.

The bulb yields of the shallot cultivars and local forms differed between two years. The yield level directly depended on both environment and genotype. Thus, 'Sh-1' (Kyivska Oblast), 'Sh-2' (Kyivska Oblast), 'Sh-6' (Dnipropetrovska Oblast), and 'Sh-10' (Chernihivska Oblast) gave high yields in 2019 (Table 2): 28.4, 24.5, 18.5, and 18.2 t/ha, respectively, which was 13.2, 9.3, 3.3, and 3.0 t/ha more than in the control cultivar ('Lira'). A good yield was also harvested from 'Sh-9', which came from the Dnipropetrovska Oblast: it yielded 16.3 t/ha of bulbs or by 1.1 t/ha more than 'Lira'. 'Sh-3' (14.8 t/ha) and 'Sh-8' (14.6 t/ha) yielded almost as much as the control cultivar. 'Sh-4' and 'Sh-11' delivered from the Kyivska and Chernihivska Oblasts, respectively, produced the lowest yields of bulbs: 11.6 and 11.2 t/ha, respectively.

Table 2. Yield capacity of the shallot local forms

Accession	Origin	Bulb yield, t/ha			Lewis's phenotypic stability factor (SF)
		2019	2020	Mean for 2019-2020	
Lira (control cultivar)	Kharkivska Oblast, UKR	15.2	15.8	15.5	1.0
Sh-1	Kyivska Oblast, UKR	28.4	32.6	30.5	1.1
Sh-2	Kyivska Oblast, UKR	24.5	26.3	25.4	1.1
Sh-3	Kyivska Oblast, UKR	14.8	15.5	15.2	1.0
Sh-4	Kyivska Oblast, UKR	11.6	12.8	12.2	1.1
Sh-5	Kyivska Oblast, UKR	14.1	15.2	14.7	1.1
Sh-6	Dnipropetrovska Oblast, UKR	18.5	19.3	18.9	1.0
Sh-7	Dnipropetrovska Oblast, UKR	11.4	12.5	12.0	1.1
Sh-8	Dnipropetrovska Oblast, UKR	14.6	15.5	15.1	1.1
Sh-9	Dnipropetrovska Oblast, UKR	16.3	19.8	18.1	1.2
Sh-10	Chernihivska Oblast, UKR	18.2	20.6	19.4	1.1
Sh-11	Chernihivska Oblast, UKR	11.2	12.5	11.9	1.1
Sh-12	Chernihivska Oblast, UKR	13.2	14.3	13.8	1.1
Sh-13	Cherkaska Oblast, UKR	12.7	13.6	13.2	1.1
Sh-14	Cherkaska Oblast, UKR	12.6	13.4	13.0	1.1
LSD 05				1.6	

The weather in 2020 was favorable for shallot growth, development and yield. The best yields in 2020 were harvested from 'Sh-1' (KyivskaOblast), 'Sh-2' (Kyivska Oblast), 'Sh-6' (Dnipropetrovska Oblast), 'Sh-9' (Dnipropetrovska Oblast), and 'Sh-10' (Chernihivska Oblast): 32.6, 26.3, 19.3, 19.8, and 20.6 t/ha, respectively. It was more than the yield harvested from the control cultivar, 'Lira', by 16.8, 10.5, 3.5, 4.0, and 4.8 t/ha, respectively.

Lower yields were harvested in 2020 from 'Sh-4' (Kyivska Oblast), 'Sh-7' (Dnipropetrovska Oblast), and 'Sh-11' (Chernihivska Oblast): from 12.5 t/ha ('Sh-11' and 'Sh-7') to 12.8 t/ha ('Sh-4'). 'Sh-3' (15.5 t/ha), 'Sh-5' (15.2 t/ha), and 'Sh-8' (15.5 t/ha) yielded almost the same as 'Lira'.

On average for the two study years, the following accessions had significantly increased yields of bulbs: 'Sh-1' (30.5 t/ha), 'Sh-2' (25.4 t/ha), 'Sh-6' (18.9 t /ha), 'Sh-9' (18.1 t/ha), and 'Sh-10' (19.4 t/ha). 'Sh-4' (12.2 t/ha), 'Sh-7' (12.0 t/ha), 'Sh-11' (11.9 t/ha), 'Sh-12' (13.8 t/ha), 'Sh-13' (13.2 t/ha), and 'Sh-14' (13.0 t/ha) yielded significantly less. 'Sh-3' and 'Sh-8' from Kyivska and Dnipropetrovska Oblasts, respectively, yielded almost the same as the control cultivar, 'Lira' (15.5 t/ha).

Adaptability in vegetatively propagated crops is of great importance, as it characterizes the biological potential of a crop. Most of the shallot accessions under investigation were collected in different regions of Ukraine, and therefore were created in different conditions. Growing of such accessions under non-optimal conditions can reduce their yields, and sometimes lead to their death. In 2019, the spring was early: as early as in May, the air temperature was higher than the optimum for shallots. In the middle of the period of bulb formation and ripening, there was an excessive amount of precipitation, contributing to mass appearance of diseases and disrupting the ripening process. All these led to a decrease in the shallot yield in 2019 compared to 2020.

The shallot accessions' adaptability differed between the two study years. 'Sh-3' (Kyivska Oblast) and 'Sh-6' (Dnipropetrovska Oblast) turned out to be best adapted to the Right-Bank Forest-Steppe. Their Lewis's phenotypic stability factors were 1. Accessions from other Oblasts were slightly worse adapted to the4 environment: 'Sh-7' and 'Sh-8' from the Dnipropetrovska Oblast, 'Sh-10', 'Sh-11', and 'Sh-12' from the Chernihivska Oblast, 'Sh-13' and 'Sh-14' from the Cherkaska Oblast. This group should include four accessions from the Kyivska oblast ('Sh-1', 'Sh-2', 'Sh-4', and 'Sh-6'), which can be explained by hereditary features. Their Lewis's phenotypic stability factors were 1.1. A local form originating from the Dnipropetrovska Oblast, 'Sh 9', was worst adapted to the growing conditions in the Right-Bank Forest-Steppe. Its Lewis's phenotypic stability factor was 1.2.

The bulb weight and number per clump directly affected the shallot yield (Table 3). The mean bulb weight per clump in 2019 ranged from 24.9 g ('Sh-1') to 9.8 g ('Sh-11'). However, good results regarding this indicator were noted for 'Sh-2' (Kyivska Oblast), 'Sh-9' (Dnipropetrovska Oblast), 'Sh-13' (Cherkaska Oblast), and 'Sh-14' (Cherkaska Oblast). The meant bulb weight was 14.3 g in the first two accessions, and 14.8 g and 14.7 g in the third and fourth accessions, respectively. In 'Lira' (control cultivar), the mean bulb weight per clump was 13.3 g. In 'Sh-3' (13.0 g), 'Sh-4' (13.5 g), 'Sh-6' (13.0 g), 'Sh-8' (12.8 g), and 'Sh-10' (12.7 g), the mean bulb weight clump was similar to that in the control cultivar.

In 2020, the weather was more favorable for the growth and development of shallot plants. Therefore, we observed an increase in the mean bulb weight per clump in some accessions and an increase in the bulb number per clump in others. The heaviest bulbs were formed in local forms that came from the Kyivska Oblast and were well adapted to the environmental conditions: 'Sh-1' and 'Sh-2'. Their mean bulb weight per clump in 2020 was 28.5 g and 15.3 g, respectively, exceeding than in the control cultivar by 14.7 and 1.5 g. The lighted bulbs were harvested from 'Sh-12' (10.0 g), 'Sh-5' (10.6 g), 'Sh-3', 'Sh-7', 'Sh-8', and 'Sh-11' (10.9 g). In 'Sh-6', the mean bulb weight per clump was 13.5 g, which was similar to that in 'Lira' (13.8 g).

On average for 2019-2020, the mean bulb weight per clump differed between the shallot cultivars and local forms. In 'Sh-1' (Kyivska Oblast), it was 26.7 g and significantly higher than that in 'Lira' (13.6 g). The lightest bulbs were noted for 'Sh-7' (10.5 g) and 'Sh-11' (10.4 g).

Plants of accessions originating from the Kyivska ('Sh-2') and Chernihivska ('Sh-10') Oblasts had the greatest number of bulbs – 6. 'Sh-3', 'Sh-5', 'Sh-6', 'Sh-8', 'Sh-9', had 'Sh-12' as many as 5 bulbs per clump. The other ac

cessions had on average 4 bulbs per clump in the conditions of the Right-Bank Forest-Steppe.

In 2019-2020, we established a pattern that the yields of most accessions increased in the favorable year due to additional bulbs per clump. This phenomenon was observed in 'Sh-3', 'Sh-4', 'Sh-5', 'Sh-8', 'Sh-9', 'Sh-10', 'Sh-12', 'Sh-13', and 'Sh-14'. In this case, the mean bulb weight per clump decreased from 0.7 g ('Sh-10') to 3 g ('Sh-14').

Table 3. Bulb weight and number per clump in the shallot local forms

Accession	Origin	Mean bulb weight per clump, g			Bulb number per clump
		2019	2020	Mean for 2019-2020	
Lira (control cultivar)	Kharkivska Oblast, UKR	13.3	13.8	13.6	4
Sh-1	Kyivska Oblast, UKR	24.9	28.5	26.7	4
Sh-2	Kyivska Oblast, UKR	14.3	15.3	14.8	6
Sh-3	Kyivska Oblast, UKR	13.0	10.9	12.0	5
Sh-4	Kyivska Oblast, UKR	13.5	11.2	12.4	4
Sh-5	Kyivska Oblast, UKR	12.3	10.6	11.5	5
Sh-6	Dnipropetrovska Oblast, UKR	13.0	13.5	13.3	5
Sh-7	Dnipropetrovska Oblast, UKR	10.0	10.9	10.5	4
Sh-8	Dnipropetrovska Oblast, UKR	12.8	10.9	11.9	5
Sh-9	Dnipropetrovska Oblast, UKR	14.3	11.6	13.0	5
Sh-10	Chernihivska Oblast, UKR	12.7	12.0	12.4	6
Sh-11	Chernihivska Oblast, UKR	9.8	10.9	10.4	4
Sh-12	Chernihivska Oblast, UKR	11.6	10.0	10.8	5
Sh-13	Cherkaska Oblast, UKR	14.8	11.9	13.4	4
Sh-14	Cherkaska Oblast, UKR	14.7	11.7	13.2	4
LSD 05				2.9	0.9

For the complex use of shallots, for both bulbs and leek during plant starting, leaf characteristics are important. In particular, it is important to evaluate plants for the leaf number and length, bulb shape and arrangement of leaves above the soil surface (Table 4). In particular, leaves can be spreading or erect, correlating with the bulb shape. Rounded bulbs are associated with spreading leaves, while elongated bulbs – with erect ones, and the latter is most valued in growing this crop for leek, especially for plant starting.

Analysis of the morphological traits of the shallot cultivars and local forms demonstrated the variability of the maximum leaf length, leaf number and bulb shape. In 2019, the maximum leaf length ranged from 30.2 cm (‘Sh-1’) to 37.3 cm (‘Sh-1’). In the control cultivar (‘Lyra’), the maximum leaf length was 32.8 cm; it was also similar (did not differ significantly from that in ‘Lira’) in ‘Sh-3’ and ‘Sh-6’ – 33.0 and 32.6 cm, respectively. Tall plants were formed by accessions from the Kyivska (‘Sh-2’) and Chernihivska (‘Sh-10’) Oblasts – 35.3 and 35.4 cm, respectively. In ‘Sh-4’, ‘Sh-7’, ‘Sh-11’, ‘Sh-12’, ‘Sh-13’, and ‘Sh-14’, the longest leaves were shorter than in the control cultivar by 1.0 -2.6 cm.

Table 4. Morphological characteristics of the shallot local forms

Accession	Origin	Maximum leaf length, cm			Leaf number per plant	Bulb shape
		2019	2020	Mean for 2019-2020		
Lira (control cultivar)	Kharkivska Oblast, UKR	32.8	35.4	34.1	28	Elliptical
Sh-1	Kyivska Oblast, UKR	37.3	38.6	38.0	28	Round-flat with downward and upward narrowing
Sh-2	Kyivska Oblast, UKR	35.3	36.2	35.8	42	Round-flat with downward narrowing
Sh-3	Kyivska Oblast, UKR	33.0	34.1	33.6	32	Elongated and cigar-shaped
Sh-4	Kyivska Oblast, UKR	30.2	31.3	30.8	25	Elongated and cigar-shaped
Sh-5	Kyivska Oblast, UKR	33.8	35.4	34.6	32	Round-flat with downward and upward narrowing
Sh-6	Dnipropetrovska Oblast, UKR	32.6	34.1	33.4	35	Elongated and cigar-shaped
Sh-7	Dnipropetrovska Oblast, UKR	30.7	32.0	31.4	28	Elongated and cigar-shaped
Sh-8	Dnipropetrovska Oblast, UKR	33.8	34.4	34.1	32	Round-flat with downward and upward narrowing
Sh-9	Dnipropetrovska Oblast, UKR	33.5	34.3	33.9	35	Round-flat with downward and upward narrowing
Sh-10	Chernihivska Oblast, UKR	35.4	37.0	36.2	39	Round-flat with downward and upward narrowing
Sh-11	Chernihivska Oblast, UKR	30.5	31.8	31.2	28	Round-flat with downward and upward narrowing
Sh-12	Chernihivska Oblast, UKR	31.8	32.8	32.3	32	Elongated and cigar-shaped
Sh-13	Cherkaska Oblast, UKR	30.8	31.4	31.1	25	Elongated and cigar-shaped
Sh-14	Cherkaska Oblast, UKR	30.2	31.9	31.5	25	Round-flat with downward and upward narrowing
LSD 05				0.77	6.5	

Analysis of the morphological traits of the shallot cultivars and local forms demonstrated the variability of the maximum leaf length, leaf number and bulb shape. In 2019, the maximum leaf length ranged from 30.2 cm (‘Sh-1’) to 37.3 cm (‘Sh-1’). In the control cultivar (‘Lyra’), the maximum leaf length was 32.8 cm; it was also similar (did not differ significantly from that in ‘Lira’) in ‘Sh-3’ and ‘Sh-6’ – 33.0 and 32.6 cm, respectively. Tall plants were formed by accessions from the Kyivska (‘Sh-2’) and Chernihivska (‘Sh-10’) Oblasts – 35.3 and 35.4 cm, respectively. In ‘Sh-4’, ‘Sh-7’, ‘Sh-11’, ‘Sh-12’, ‘Sh-13’, and ‘Sh-14’, the longest leaves were shorter than in the control cultivar by 1.0 -2.6 cm.

The more favorable weather conditions in 2020 affected the length of shallot leaves. The best values of this parameter were recorded for accessions from the Kyivska (‘Sh-1’ and ‘Sh-2’) and Chernihivska (‘Sh-10’) Oblast: 38.6, 36.2, and 37.0 cm, respec-

tively, which were by 3.2, 0.8, and 1.6 cm shorter than 'Lira' longest leaves. 'Sh-4' (31.3 cm), 'Sh-7' (32.0 cm), 'Sh-11' (31.8 cm), 'Sh-12' (32.8 cm), 'Sh-13' (31 .4 cm), and 'Sh-14' (31.9 cm) had the shortest leaves.

On average for the two study years, the longest leaves were formed by 'Sh-1' and 'Sh-2' (Kyivska Oblast) and 'Sh-10' (Chernihivska Oblast): 38.0, 35.8 and 36.2 cm, respectively. Significantly shorter leaves were formed by 'Sh-4' (Kyivska Oblast; 30.8 cm), 'Sh-7' (Dnipropetrovska Oblast; 31.4 cm), 'Sh-11' (Chernihivska Oblast; 31.2 cm), 'Sh-12' (Chernihivska Oblast; 32.3 cm), 'Sh-13' (Cherkaska Oblast; 31.1 cm), and 'Sh-14' (Cherkaska Oblast; 31.5 cm). There were no significant differences in this parameter between 'Sh-3', 'Sh-5', 'Sh-6', 'Sh-8', and 'Sh-9'. Their maximum leaf length ranged from 33.4 cm ('Sh-6'; Dnipropetrovska Oblast) to 34.6 cm ('Sh-5', Kyivska Oblast).

As to the leaf number per plant, all the accessions under investigation were similar to the control cultivar, 'Lira', which had 28 leaves per plant on average for the two years. Two accessions from the Kyivska and Chernihivska Oblasts ('Sh-2' and 'Sh-10') turned out to be exceptions in terms of this parameter: their leaf number per clump was 42 and 39, respectively.

Conclusions. Data demonstrated that, on average for 2019-2020, the control cultivar, 'Lira', and a local form from the Dnipropetrovska Oblast, 'Sh-8', had the shortest growing periods of 74 days. 'Sh-1' (Kyivska Oblast) had the longest growing period: as long as 86 days.

The highest yields of bulbs were harvested from the following local forms: 'Sh-1' (30.5 t/ha), 'Sh-2' (25.4 t/ha), 'Sh-6' (18.9 t/ha), 'Sh-9' (18.1 t /ha), and 'Sh-10' (19.4 t/ha). The worst yields were given by 'Sh-4' (12.2 t/ha), 'Sh-7' (12.0 t/ha), 'Sh-11' (11.9 t/ha), 'Sh-12' (13 .8 t/ha), 'Sh-13' (13.2 t/ha), and 'Sh-14' (13.0 t/ha).

On average for the two study years, the yield in 2020, which was a favorable year for growing shallots, was increased in most accessions due to increased number of bulbs per clump. This phenomenon was noticed for 'Sh-3', 'Sh-4', 'Sh-5', 'Sh-8', 'Sh-9', 'Sh-10', 'Sh-12', 'Sh-13', and 'Sh-14'. In this case, the mean bulb weight per clump decreased from 0.7 g ('Sh-10') to 3 g ('Sh-14').

The greatest bulb weight per clump of 26.7 g was recorded for an accession originating from the Kyivska Oblast, 'Sh-1'. The lightest bulbs were formed by 'Sh-7' (10.5 g) and 'Sh-11' (10.4 g).

As to the bulb number per clump, two accessions stood out: 'Sh-2' and 'Sh-10', which had 6 bulbs per clump. Good values of this parameter were also observed in 'Sh-3', 'Sh-5', 'Sh-6', 'Sh-8', 'Sh-9', and 'Sh-12': 5 bulbs per clump.

The maximum leaf length was recorded for 'Sh-1' (38.0 cm), 'Sh-2' (35.8 cm), and 'Sh-10' (36.2 cm). However, the largest number of leaves per plant was observed in 'Sh-2' (42), 'Sh-6' (35), 'Sh-9' (35), and 'Sh-10' (39).

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