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# BOTANY

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## SELECTION OF WINTER SHOOTING GARLIC VARIETIES FOR GROWING IN THE CONDITIONS OF THE FOREST-STEPPE OF THE RIGHT BANK OF UKRAINE

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**Анотація**

В результаті проведених досліджень по вивченню сортів часнику стрілкуючого озимого в умовах Лісостепу Правобережного України встановлено, що досліджувані сорти характеризувалися різною врожайністю та якістю продукції. Так, найбільшу урожайність забезпечив сорт Любаша – 14,5 т/га, де приріст відносно контролю становив – 0,8 т/га. Найбільший діаметр цибулини був у сорту Любаша – 4,4 см, що на 0,3 см більше за контроль. Найбільшу масу сформували цибулини сорту Любаша – 65,4 г, що більше за контроль на 3,9 г.

**Abstract**

As a result of research on the study of varieties of winter shooting garlic in the Forest-Steppe of the Right Bank of Ukraine, it was found that the studied varieties were characterized by different yields and product quality. Thus, the highest yield was provided by the Lyubash variety – 14.5 t / ha, where the increase relative to control was – 0.8 t / ha. The largest diameter of the bulb was in the variety Lyubasha – 4.4 cm, which is 0.3 cm larger than the control. The largest mass was formed by bulbs of the Lyubasha variety – 65.4 g, which is 3.9 g more than the control.

**Ключові слова**: часник озимий, сорт, морфологія, біометрія, урожайність.

**Keywords:** winter garlic, variety, morphology, biometrics, yield.

**Formulation of the problem.** Of the vegetable crops in recent years, more attention is paid to the cultivation of garlic, in particular the winter shooting form. It is cultivated in all soil and climatic zones of Ukraine [10]. In terms of distribution among onion crops, it ranks second after onions [1]. However, in Ukraine, its area is not significant and does not exceed 1% of the total occupied by vegetable crops. According to statistics in 2017, this is about 1000 hectares, not taking into account the fact that garlic as a whole has a leading place in the private sector, and its share in private farms in Ukraine is quite significant [11]. The average yield of winter varieties in the country is low - 6-8 t / ha, spring – 1-3 t / ha [2, 20]. Therefore, the production of commercial garlic meets the needs of the population, meat, canning industry by 20-25%, the rest – replenish purchases from the population and imports from abroad [17].

The annual demand for garlic in recent years has been 0.8 kg per person, of which 0.6 – fresh and 0.2 – canned [3]. Garlic is sensitive to changes in soil and climatic conditions and adapts poorly to them. Therefore, the transportation of planting material to other soil and climatic conditions is inefficient, because within a few years it degenerates. To increase yields, it is best to use varieties created in the area where it is grown [4, 8].

**Analysis of recent research and publications.** Garlic (*Allium sativum L.*) is an annual, herbaceous, cold-resistant crop. It belongs to the family Bulbous (*Ariaseae*) and the botanical genus (*Allium L.*) [5, 7, 15]. The genus Allium has nearly 600 species, which are distributed throughout the eastern hemisphere, but mostly in Asia Minor and Central Asia. The wild form of garlic was A. longicuspis Regel., Which is common in mountainous and foothill areas of Central Asia [6, 14]. Its plants did not differ in appearance from garlic, except for underground bulbs. The latter in the wild are small, often not divided or consisted of several teeth. However, wild garlic quickly adapted to the created cultivation conditions, as a result of which the underground bulbs did not differ in shape, size and number of teeth from cultivated plants grown in the same conditions [18].

Garlic is one of the oldest vegetable crops [19, 21]. The first reliable data about it date back to the period of Ancient Egypt (5 thousand years BC). During the construction of pyramids, tombs of pharaohs and other monumental structures in ancient Egypt, garlic was added to food to increase the efficiency of slaves, as well as a preventive measure against disease. 400 years BC is. in ancient Greece it was used as a stimulant and as an antidote to snake bites. The Romans believed that garlic was a plant that added courage, and used legionnaires to feed the fighting spirit [12, 16].

Garlic is consumed fresh and marinated, used in the meat canning and sausage industries. In cooking, it is indispensable during pickling and marinating vegetables, making sausages, jellies, fish and mushroom dishes [3, 12]. Salads, soups, borscht, etc. are made from young leaves. Adding garlic to vegetable, meat and fish products prolongs their shelf life [14].

Garlic also increases the body's resistance to colds and other infectious diseases, improves appetite, improves digestion, heart function, dilates blood vessels, lowers blood sugar, supports brain cell function, has antiseptic, antiseptic and analgesic properties [7, 20 , 21]. Garlic volatiles inhibit the activity of enzymes that affect the growth of cancerous tumors [11, 15, 18]. They have the ability to remove harmful substances from the human body – lead, mercury, cadmium, etc. Garlic is used to make many drugs, including alahol, allylsat, defensonate, allicin, sativin, alizantin, carbalyl [19].

Garlic is a cold-resistant, herbaceous plant [4, 12]. Shooting varieties of winter garlic are more winter-hardy than non-shooting. Depending on the timing of planting in the fall, rooted teeth accumulate sugars in different ways, which are an important source of overwintering plants. Winter garlic successfully overwinters under snow in the most severe winters, when the air temperature drops to minus 25-30 ° C. Garlic is a long daylight plant [19]. Garlic plants develop best during the day 16-18 hours [11]. The optimal soil moisture during the period of vegetative growth is 80-85% (GPV), and for better ripening of bulbs and harvesting – 60-65% of GPV [4].

Despite the antiquity of garlic and its almost widespread cultivation and consumption, the varietal composition remains insignificant. It has always been customary to divide its varieties into three types: winter shooting and non-shooting and spring non-shooting. The latest scientific data show that the division of garlic into winter and spring forms is conditional. The same varieties in different climatic conditions can be propagated in both winter and spring crops [13, 17, 21]. The local variety of garlic is very large, but each variety and population has a narrow distribution area [12].

A feature of garlic is increased conservatism and poor adaptation to new growing conditions [3, 17]. Thus, varieties are imported from north to south, and vice versa, for a long time adapt to new soil and climatic conditions, change morphological and biological characteristics, underground bulbs are rapidly shrinking and can not compete with local [14, 17, 20]. However, it happens that non-shooting varieties become shooting mainly with weakened shooting [6]. Pests and diseases damage these plants, which leads to a rapid loss of economic value. However, there are many imported varieties that have not adapted to the new soil and climatic conditions of the zone and have disappeared. This number is sometimes up to 40-50 % of their total [2, 12].

Such a weak adaptive ability of garlic varieties imported from other soil-climatic zones is a consequence of a purely vegetative method of reproduction, as a result of which new members of the population arise under the influence of somatic mutations (genetic changes of vegetative cells). They do not exchange genes with adjacent populations [14, 19, 20].

Scientists note that the importance of adaptation of the variety to specific environmental conditions, as well as their different behavior in different agroclimatic zones [17]. However, there is another opinion that with increasing yields of varieties decreases the breadth of their adaptive capabilities.

Given the ability of garlic varieties to respond to changes in growing conditions, you need to be careful when growing imported local varieties, because the most stable forms of garlic, which have repeatedly multiplied in this area. Since each variety of garlic has its advantages and disadvantages, it is advisable to select planting material in the area where the variety will be grown or close to it [11, 14, 18].

Currently in Ukraine, the Institute of Vegetable and Melon UAAS and Uman Agrarian University are engaged in selection work to create and improve garlic varieties. The Department of Vegetable Growing conducts selection of varieties and develops technological elements for growing winter and spring garlic. In addition, selection work is carried out to create and update its varieties in Kyiv and revived at Skvyra research stations [18, 20].

**The purpose of research.** The purpose of research work is to study the influence of varieties on the growth, development and yield of winter winter garlic in the Forest-Steppe Right Bank.

**Research methodology.** Studies on the study of varieties of winter shooting garlic in the experimental field of VNAU were conducted in 2018-2019. Field experiments were laid out in randomized blocks. During the research according to the methodology of the research case, the scheme of the experiment was developed, as well as observations, accounting and calculations were performed [9].

Phenological observations were performed on ten plants. The appearance of seedlings, the appearance of 2-, 4-, 6th leaves, the beginning of shooting were noted. The beginning of the phase was recorded when it occurred in 10% of plants in the area, mass-75% [9, 13].

Biometric measurements were performed during the growing season of plants [9]. The following indicators were recorded: length and width of leaves [13]. At the beginning of the arrow, the height of the plants and the thickness of the false stem were measured.

Harvesting of garlic and its accounting were performed from each plot separately. After removing the false arrow stem and roots, the underground bulbs

were sorted into marketable and non-marketable parts and weighed separately [9].

Variants of the experiment were varieties: Sofiyivsky, Promin, Dobrodiy, Lyubasha. The Sofiyivsky variety was chosen for control. Repeat four times. Yield indices obtained in the experiments were processed by the method of analysis of variance [9].

**Research results.** Based on the observations, it was found that the dates of the phenological phases of winter garlic differed significantly and depended on the studied variety (Table 1).

**1. To give the onset of phenological phases in winter garlic shoots depending on varietal characteristics, 2018-2019.**

| Variety | The emergence of stairs | The appearance of the next leaf | | | Start shooting |
|---|---|---|---|---|---|
| | | second | fourth | sixth | |
| Sofievsky (control) | 5.04 | 9.04 | 16.04 | 30.04 | 29.05 |
| Promin | 7.04 | 12.04 | 20.04 | 4.05 | 5.06 |
| Dobrodiy | 6.04 | 10.04 | 18.04 | 1.05 | 1.06 |
| Lyubasha | 7.04 | 12.04 | 20.04 | 3.05 | 3.06 |

Thus, seedlings in the Sofiyivskyi (control) variety appeared 1 day earlier than the Dobrodiy variety and 2 days earlier than the Promin and Lyubasha varieties. The second leaf in the Sofiyivsky variety was noted on April 9, while in the other studied varieties 1 – 3 days later. The fourth leaf in the varieties Promin and Lyubasha was formed on the 13th day after germination, which is 4 days later compared to the control. In the variety Dobrodiy, the phase of appearance of the fourth leaf was observed on 18.04, which is 2 days later than the control variant. Most likely, the fourth leaf appeared in the control on the 11th day after emergence, which is 2-4 days earlier than other studied varieties. The phase of the beginning of shooting in garlic plants was previously observed in the variety Sofiyivsky – 29.05, which is 3-7 days earlier than the varieties Dobrodiy, Promin and Lyubasha. The latest start of shooting was observed in the variety Promin – 5.06.

According to the results of phenological data, the duration of interphase periods of winter shooting garlic was calculated (Table 2).

**2. Duration of interphase periods in winter shoot garlic plants depending on varietal characteristics, 2018-2019.**

| Variety | The emergence of the ladder – the beginning of the shooting | Formation of the next leaf, days from a ladder | | |
|---|---|---|---|---|
| | | second | fourth | sixth |
| Sofievsky (control) | 54 | 4 | 11 | 25 |
| Promin | 59 | 5 | 13 | 27 |
| Dobrodiy | 56 | 4 | 12 | 25 |
| Lyubasha | 57 | 5 | 13 | 26 |

Thus, the shortest period from the emergence of seedlings to the beginning of shooting is set in the variety Sofiyivsky (control) – 54 days. The longest period was observed in the variety Promin – 59 days, which is 5 days longer compared to the control. In varieties Dobrodiy and Lyubasha this interphase period was 56 and 57days, respectively. The formation of the 2nd leaf was previously observed in the varieties Sofiyivsky and Dobrodiy – on the 4th day, and in the varieties Promin and Lyubasha on the 1st day later. In these varieties, too, later noted the appearance of the 4th leaf – 13 days, which is 2 days later compared to the control. In plants of the Promin variety, the 4th leaf appeared 1 day later than the control. The appearance of the 6th leaf in the studied varieties of garlic was observed for 25 – 27 days. The last 6th leaf was formed by plants of the Promin variety on the 27th day, which is 2 days later than the control. Lyubasha variety – for 26 days.

Biometric measurements of plants were performed during the research to better evaluate the varieties of winter shooting garlic. According to the obtained data, we found that the plant height, stem thickness and leaf area were influenced by the studied varieties (Table 3).

**3. Biometric indicators of winter garlic plants in the phase of the 5th leaf, 2018-2019.**

| Variety | Height of plants, cm | Thickness of stem , mm | Area of leaves, thousands $m^2$/ha |
|---|---|---|---|
| Sofievsky (control) | 29,5 | 0,8 | 9,5 |
| Promin | 29,0 | 0,7 | 8,7 |
| Dobrodiy | 30,5 | 0,9 | 9,8 |
| Lyubasha | 31,8 | 1,0 | 10,4 |

Lyubasha plants had the highest height - 31.8 cm, and in the control - 29.5 cm, which is 2.3 cm less. In the variety Dobrodiy the indicator of plant height was at the level of 30.5 cm, which is 1.0 cm higher than the control variant. The lowest indicator was in the variety Promin

– 29.0 cm, which is 0.5 cm less than the control variant and 1.5-2.8 cm less varieties Dobrodiy and Lyubasha.

The thickness of the stem of winter shooting garlic plants ranged from 0.7 to 1.0 cm. The thickness of the stem was greater than the plants of the Lyubasha variety and on average it was 1.0 cm, which is 0.2 cm more than the control. Was slightly smaller than the Lyubash variety, but 0.1-0.2 cm larger than the Promin and Sofiyivsky varieties (control).

The indicator on which the yield of winter shoot garlic plants depends is the leaf area. The largest area of leaves in winter shoot garlic plants was observed in the variety Lyubash – 10.4 thousand $m^2$ / ha, which is 0.9 thousand $m^2$ / ha more than the variety Sofiyivsky (control). Slightly larger area of winter shoot garlic leaves – by 0.3 thousand $m^2$ / ha was formed by plants of the Dobrodiy variety – 9.8 thousand $m^2$ / ha. The lowest indicator was in the variety Promin – 8.7 thousand $m^2$ / ha, which is less than the control by 0.8 thousand $m^2$ / ha.

To better study the range of garlic winter shooter biometric measurements were performed in the start phase of shooting (Table 4)

**4. Biometric indicators of winter garlic plants in the phase of the beginning of shooting, 2018-2019.**

| Variety | Height of plants, cm | Thickness of stem , mm | Area of leaves, thousands $m^2$/ha |
|---|---|---|---|
| Sofievsky (control) | 57,8 | 1,4 | 28,6 |
| Promin | 58,2 | 1,4 | 25,8 |
| Dobrodiy | 59,4 | 1,5 | 29,6 |
| Lyubasha | 61,3 | 1,6 | 32,4 |

Varietal features influence the biometric parameters of winter shoot garlic plants. Thus, the plants of Lyubasha variety had the highest height – 61.3 cm, which is 3.5 cm more than the control. For Promin and Dobrodiy varieties this indicator was 58.2 and 59.4 cm, respectively. The lowest plant height was observed in the control – 57.8 cm.

The thickness of the stem among the studied variants did not differ significantly and was 1.4 – 1.6 cm. In the variety Lyubasha this figure was the largest and amounted to - 1.6 cm, which is more than control by 0.2 cm. stems – 1.4 cm.

The largest area of leaves was formed by the garlic variety of winter shooter Lyubash – 32.4 thousand $m^2$ / ha, and in the control – 28.6 thousand $m^2$ / ha, which is 3.8 thousand $m^2$ / ha less. In the Dobrodiy variety, the plants formed a leaf area of 29.6 thousand $m^2$ / ha, which is more than the control of 1.0 thousand $m^2$ / ha. The smallest area of leaves was formed by garlic plants of the winter shooting variety Promin – 25.8 thousand $m^2$ / ha, which is less than the control by 2.8thousand $m^2$ / ha.

Thus, the duration of interphase periods and biometric parameters of plants indicate the influence on them of varietal characteristics of winter garlic.

Yield is the most important indicator of the end result of research. It reflects the reality of the choice and introduction of a variety in production for a particular soil and climatic zone of cultivation. To do this, the analysis of varieties is carried out, they are tested first in the experimental areas, the necessary technologies are used during cultivation and, on the basis of observations, the discrepancy between the influence of certain factors is corrected.

The choice of variety significantly affects the yield of garlic winter shoot. At the time of the research, the yield fluctuated within certain limits (Table 5), which respectively depended on environmental factors, anthropogenic impact, ie the use of cultivation technologies, and, accordingly, the impact of the characteristics of the variety.

**5. Yield of underground bulbs of winter winter garlic, 2018-2019.**

| Variety | Yield capacity, t/ha | ± before control | |
|---|---|---|---|
| | | t/ha | % |
| Sofievsky (control) | 13,7 | 0 | 100 |
| Promin | 12,1 | -1,6 | -0,12 |
| Dobrodiy | 14,0 | +0,3 | +102 |
| Lyubasha | 14,5 | +0,8 | +106 |
| $HIP_{0,5}$ | 0,5 | - | |

The highest yield was observed in the variety Lyubasha – 14.5 t / ha, where the increase relative to control was – 0.8 t / ha. The Dobrodiy variety provided a yield of 14.0 t / ha, and in the control – 13.7 t / ha, which is 0.3 t / ha less. The lowest yield among the studied varieties of winter shoot garlic was obtained from the variety Promin – 12.1 t / ha, which is less than the control by 1.6 t / ha. Lyubasha variety had significantly higher yields in terms of control. The significance of this difference is confirmed by the results of analysis of variance. The variety factor influenced the yield of winter garlic plants with a force of 91%.

The yield was influenced by the biometric indicators of the underground bulbs of winter garlic (Table 6). Thus, the highest height was underground bulbs of garlic winter shooting variety Lyubasha – 4.7 cm, which is more than the control variant by 0.4 cm and Dobrodiy variety by 0.1 cm. The lowest this indicator was in the variety Promin – 4.0 cm, which less than the control option by 0.3 cm

**6. Biometric indicators of underground bulbs of winter winter garlic, 2018-2019.**

| Variety | Number of fruit, p/plant | Weight of fruit, g | Fruit diameter, cm |
|---|---|---|---|
| Sofievsky (control) | 4,3 | 4,1 | 61,5 |
| Promin | 4,0 | 3,8 | 54,3 |
| Dobrodiy | 4,6 | 4,3 | 63,2 |
| Lyubasha | 4,7 | 4,4 | 65,4 |

The same pattern was obtained for the diameter of the underground bulbs of winter garlic. In particular, the highest this indicator was in the variety Lyubasha – 4.4 cm, and in the control by 0.3 cm less. The underground bulbs of Promin garlic had the smallest diameter – 3.8 cm, which is 0.3 cm less than the control.

The mass of underground bulbs of winter shoot garlic was 54.3 – 65.4 g. It was the largest in the variety Lyubasha – 65.4 g, which is 3.9 g more than the control and 2.2 g more than the variety Dobrodiy. The smallest mass of underground bulbs of winter winter garlic was in the variety Promin – 54.3 g.

**Conclusions and prospects for further research.** Thus, according to the research, it was established that the varietal characteristics of winter shoot garlic varieties had an impact on the yield of underground bulbs and their biometric indicators. The highest yield was observed in the variety Lyubasha – 14.5 t / ha, where the increase relative to control was – 0.8 t / ha. It was the largest in the variety Lyubasha – 65.4 g.

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