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SOWING DATE OF SPINACH HYBRIDS

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The study was conducted in 2019–2021, in the conditions of the Southern Steppe of Ukraine. The results on the influence of sowing date on the plans productivity of spinach are presented. For our research were used field, statistical, calculation-analytical and laboratory methods. Hybrides Boa F1 and Odysseus F1 were studied. We studied the behavior of plants after six sowing dates. The conveyor growing of spinach should ensure an uninterrupted supply of fresh green products during the spring-summer-autumn period. First sowing was conducted at first decade of April. Second sowing was conducted at third decade of April. Four next sowing were done at second decade of May, at second decade of June, and first decade of August and the last one at third decade of August. Control variant was Boa F1 hybrid after sowing date at first decade of April. We found that plants of both spinach hybrids had a larger more leaves and leaf surface during the early sowing dates. At the phase of beginning of rosette growth it was 114.2–127.7 cm²/plant. At the same time plants which were sown in August had a smaller more leaves and leaf surface – 86.0–106.2 cm²/plant. The highest yield of marketable green mass was obtained for sowing in the III decade of April and the II decade of May depending on the hybrid. So, the Boa F1 hybrid provided 22.9–23.0 t/ha, and the Odysseus F1 hybrid provided 23.3–23.9 t/ha. Such yield was higher than the control variant by 3.2–4.2 t/ha. It was found that there is a strong positive correlation between plant weight and the number of leaves ($r = 0.98$), the yield of spinach and the plant weight ($r = 0.91$). Such practice of conveyor sowing of spinach can be recommended to farmers and private farms who grow vegetables for to extend the terms of receipt of fresh greens from early spring to autumn from – the third decade of April to the end of September, and in some years even until mid-October.

Key words: spinach, hybrid, sowing date, growth, leaves number, leaves surface, yield.

Шевчук К.М. Строки сівби гібридів шпинату

Дослідження проводили у 2019–2021 рр. в умовах Південного Степу України. Наведено результати щодо впливу строків сівби на планову продуктивність шпинату. Для дослідження були використані польові, статистичні, розрахунково-аналітичні та лабораторні методи. Досліджено строк сівби гібридів Boa F1 та Одиссей F1. Вивчали поведінку рослин після сівби у шість строків. Конвеєрне вирощування шпинату городнього має забезпечувати безперебійне постачання свіжої зелені упродовж весняно-літньо-осіннього періоду. Перший посів проводили в першій декаді квітня. Другий посів проводили в третій декаді квітня. Чотири наступні посіви проводили у другій декаді травня, у другій декаді червня та першій декаді серпня і останній у третій декаді серпня. Контрольним варіантом був гібрид Boa F1 за строком сівби I декада квітня. Встановлено, що рослини обох гібридів шпинату мали більшу кількість листків і листову поверхню за ранніх строків сівби. У фазі початку росту розетки листову поверхню становила 114,2–127,7 см²/рослину. Водночас рослини, які висівали в серпні, мали меншу кількість листків і площу листової поверхні – 86,0–106,2 см²/рослину. Найбільший урожай товарної зеленої маси отримано за сівби в III декаді квітня та у II декаді травня залежно від гібриду. Так, гібрид Boa F1 забезпечив 22,9–23,0 т/га, а гібрид Одиссей F1 – 23,3–23,9 т/га. Така врожайність була вищою за контрольний варіант на 3,2–4,2 т/га. Встановлено, що існує сильний позитивний кореляційний зв'язок між масою рослини та кількістю листків ($r = 0,98$), урожайністю шпинату та масою рослини ($r = 0,91$). Таку практику сівби шпинату городнього за різних строків можна рекомендувати фермерам та особистим селянським господарствам, які вирощують овочі, щоб продовжити терміни отримання свіжої зелені від ранньої весни до осені – з третьої декади квітня до кінця вересня, а в окремі роки навіть до середини жовтня.

Ключові слова: шпинат, гібрид, строк сівби, ріст, кількість листків, поверхня листків, урожайність.

Formulation of the problem. Most green plants that are used fresh have a fairly short shelf life. If the optimal conditions of transportation, storage, and sale of the green mass of such plants are observed, the storage period is 5–20 days. Therefore, only conveyor belt cultivation of garden spinach makes it possible to provide the consumer with fresh green vegetable products for a long period of time. Thus, in Ukraine, only 4% of the annual amount of vegetables is produced in March-April, 10% in May-June, 58% in July-September, 25% in October-November, and about 3% in December-February.

Due to the fact that the conveyor cultivation of garden spinach is closely related to the biology of the plant and climatic conditions, it is possible to provide the consumer with a sufficient amount of fresh green products for a long period.

The analysis of literary sources does not shed light on the solution to the issue of conveyor belt cultivation of garden spinach. Taking into account the above, in our research it was planned to study the morphobiological features of the plant, soil and climatic conditions, in order to develop a scheme for conveyor cultivation of the green mass of garden spinach for the uninterrupted supply of green products to processing points and the population from April to September.

Analysis of recent research and publications. Numerous studies have established that the sowing date effects on the stability, overall survival, water consumption and productivity of plants. It is known that from early to late sowing the accumulation of dry matters consistently decreases. The intensity of the processes of plant and stem death during the spring-summer vegetation period decreases. At the optimal sowing date plants are programmed for high yield, but their productivity decreases both at early and at late sowing date. In the first case, the plant forms a larger vegetative mass and, because of overgrowth, intensively uses reserve substances and becomes less resistant to adverse conditions. In addition, the plant of the early sowing is more damaged by pests, diseases, and is often weedier. Because weeds, by their biological characteristics, are more competitive with plants, they outgrow and shade them, take more nutrients and moisture. All this leads to slowdown in the growth of cultivated plants, thinning of crops and a decrease in yield [1, c. 112–116; 2, c. 39–44; 7, c. 320].

Plants of the late sowing grow and develop more slowly, do not have time to form a full-fledged rosette and sufficient above-ground mass and secondary root system [3, c. 147–151; 8, c. 981–990].

The study of the dependence of the sowing date on soil fertility showed that it is necessary to sow earlier on poor soils, and later on fertile ones, so that the plants do not overgrow. The optimal sowing date on fertilized fields is shifted 10–15 days later, compared to sowing on a less fertilized field [4, c. 225–227; 9, c. 42–43].

The sowing date varies depending on the biological characteristics of the variety, and for classic varieties, the interval of the optimal sowing period is longer. The calendar dates for sowing are 6–12 days later, compared to previously grown varieties, which is due to the biological features of the modern variety. And this is a shortened epicotyl, faster passage of the interphase period, more intense formation of plastic substances and formation of above-ground mass [5, c. 109–113; 10, c. 619–627].

The results of observations of the growth and development of plants in the autumn period showed that the degree of plant development, especially the accumulation of dry matter, is not directly related to the level of adaptive characteristics. They are formed higher during optimal and late sowing [6, c. 10–13; 12, c. 118–124; 13, c. 388–393].

Plants of different ages do not equally consume water from the soil. Crops of early sowing, as they are more physiologically old, use less water than plants of optimal and late sowing [7, c. 321–323; 14, c. 118].

For vegetables, in particular of spinach, the sowing date is important, because the optimal sowing date will help to increase the yield due to the full growth and development of the plant. Therefore, in order to obtain a high yield of green mass several times during the growing season in the Southern Steppe of Ukraine, research was conducted to study the effectiveness of the sowing date for growing spinach.

Setting objectives. The purpose of the work is to determine the influence of the sowing period on the yield and quality of garden spinach grown in the conditions of the Southern Steppe of Ukraine. Research on determining the optimal sowing date in the conditions of the Southern Steppe of Ukraine was conducted in 2019–2021 under conditions of drip irrigation. It was determined the influence of the sowing date on the growth, development and yield of the green mass of spinach. The hybrids Boa F1 and Odysseus F1 were used in accordance with methodology of Bondarenko & Yakovenko (2001) [11, C. 119–133].

The control was sown in I decade of April. In order to create a conveyor for the constant supply of fresh product during the spring-summer-autumn period were studied next sowing dates: I and III decades of April, II decade of May, II decade of June, I and III decades of August.

Presentation of the main research material. The sowing of the spinach at different dates shows a positive effect on the results of farming and allowed to obtain reliable data on the plasticity of the crop in terms of growing conditions. The assessment of the influence of the date of the seeds sowing on the growth and development of the spinach under the conditions of growing in open field was conducted based on the fixation of the duration of the phenological phases of plant growth, their development and other indicators. The analysis of the data obtained as a result of research on the growth of the spinach plants and their development in the Southern Steppe of Ukraine showed that the duration of the periods from the germination to the onset of the main phenological phases was the shortest for sowing seeds in the I and II decades of August, regardless of the studied hybrid. The mass germination appeared on the 8th day in the control variety and on the 7th day in the hybrid Odysseus F1 due to sowing seeds in the I decade of April. The mass germination of both researched varieties was noted for 6 days due to sowing seeds in the III decade of April and II decade of May as well as in the hybrid Odysseus F1 due to sowing in the II decade of June. During the August sowing dates, mass germination was recorded at 5th day, regardless of the studied hybrid, which can be associated with the influence of high environmental temperatures.

The phase of the appearance of the first true leaf in spinach was recorded after 10–17 days, depending on the variant of the experiment, and it was noted after 12–17 days for the hybrid Boa F1, and 10–15 days for the hybrid Odysseus F1.

The plants reached the technical phase of maturity on the 40th day after the appearance of germination in both studied hybrids due to sowing seeds in the III decade of April and on the 41st day due to sowing seeds in the II decade of May. The summer sowing date showed that the onset of the technical maturity phase did not depend on the hybrids and occurred on the 37th and 38th day.

The study of the effect of the hybrid and date of sowing seeds on the duration of the growth phases proves that for all sowing dates the advantage is observed in plants of the hybrid Odysseus F1 the phase of technical maturity came 1–4 days earlier than in the hybrids Boa F1. In its turn, studies have shown that the difference in the speed of passage of phenological phases by spinach plants is more pronounced depending on the date of sowing than on the hybrids.

The influence of the sowing date of spinach and the hybrids is characterized by differences in biometric indicators. The evaluation of the plants of the hybrids Boa F1 and Odysseus F1 in the phase of the beginning of rosette growth shows that plants had height of 6.3–7.3 cm due to the sowing in the III decade of April and in the II decade of May and were taller compared to the plants of later sowing. This fact can be explained by the fact that at lower temperatures the growing season is longer.

An exception to this pattern can be considered the sowing period in the I decades of April, when at the beginning of the growing season, low temperatures, on the contrary, slowed down the growth and development of spinach plants.

It was noted that the height of spinach plants depended to a considerable extent on the sowing date and not on the hybrid. On average, over the years of research, the height of city spinach plants in the phase of green technical maturity, was 24.8–28.2 cm, depending on the hybrid due to sowing in the I decade of April. The research indexes differed and in the hybrid Boa F1 they increased to 26.6–28.9 cm, while in the hybrid Odysseus F1, on the contrary, they decreased to 25.7–26.5 cm due to the sowing of spinach in the III decade of April and in the II decade of May. The indexes of both studied hybrids exceeded the control by 1.8–4.1 cm and 0.9–1.7 cm, respectively.

It has been established that in spinach the number of leaves per plant determines the potential value of the yield, therefore, in the conducted observations, we attached great importance to this index.

In the phase of the beginning of plant rosette growth the number of leaves was, depending on the investigated hybrid, from 5.0 to 6.0 pcs/plant. Observations of 2019–2021 showed us that early sowing dates, especially the III decade of April, the II decade of May and the II decade of June, were more conducive for the hybrid Boa F1, as one plant formed a larger number of leaves from 5.7 to 6.0 pcs/plant. At the time when a significantly lower number of leaves from 5.0 to 5.2 pcs/plant was observed due to late sowing and sowing in the I decade of April. In its turn, in the hybrid Odysseus F1, the number of leaves varied slightly regardless of different sowing dates and ranged from 5.0 to 5.4 leaves per plant.

It was noted that the studied hybrids had different numbers of leaves at the phase of the beginning of the rosette growth. High variability of the index was noted in the Boa F1 hybrid with the highest index due to the sowing in the II decade of May.

During the studies of the influence of the hybrids and sowing date on the number of leaves and their growth throughout the growing season, it should be noted that at the harvesting date the number of leaves increased by 2.5–3.5 times, from 5.0–6.0 to 14–21 pcs/plant.

One of the important indexes of spinach plant growth, which determines their value as a green plant, is the leaf surface and the total leaves surface. The determination of these indexes depending on the date of sowing was conducted at the beginning of the rosette growth and in the phase of technical maturity of the greenery before the bolting (Table 1).

It was established that plants of the Boa F1 hybrid had a larger leaf surface due to sowing in the I decade of April – 22.0 cm²/plant. The smallest leaf surface in the hybrid Boa F1 was found due to sowing seeds in the I decade of August – 17.1 cm²/plant. At the same time, in the hybrid Odysseus F1, the smallest leaf surface was observed due to sowing in the last term – 18.5 cm²/plant, and the largest due to the III decade of April – 23.6 cm²/plant.

The study of the influence of sowing dates on the leaf surface index proves that it is larger at the beginning of growth due to sowing in the III decade of April and the II decade of May, regardless of the hybrid.

Table 1
The spinach leaf surface in different mode of growth and development depending on the hybrid and sowing date, cm²/plant

hybrid	Sowing date	Beginning of rosette growth				Technical maturity			
		2019	2020	2021	2019–2021	2019	2020	2021	2019–2021
Boa F1	April I decade*	18.8	17.7	18.5	18.3	110.3	108.3	107.2	108,6
	April III decade	20.4	21.7	23.8	22.0	122.4	120.6	122.0	121,7
	May II decade	21.5	20.8	19.9	20.7	128.5	128.7	125.9	127,7
	June II decade	21.8	20.9	20.5	21.1	105.8	107.8	111.4	108,3
	August I decade	17.4	16.7	17.1	17.1	96.4	86.3	76.2	86,3
	August III decade	18.4	18.1	18.5	18.3	84.6	88.4	85.1	86,0
Odysseus F1.	April I decade	24.1	21.3	21.7	22.4	120.1	110.6	115.2	115,3
	April III decade	25.7	22.1	22.9	23.6	130.1	121.4	124.7	125,4
	May II decade	22.3	21.5	22.2	22.0	115.7	110.5	116.5	114,2
	June II decade	21.7	20.7	22.5	21.6	114.4	117.7	118.0	116,7
	August I decade	19.4	18.3	18.8	18.8	111.5	101.5	105.6	106,2
	August III decade	19.1	18.1	18.3	18.5	109.9	102.2	104.1	105,4
<i>LSD</i> ₀₅	<i>Factor A</i>	0.4	0.5	0.7					
	<i>Factor B</i>	0.7	0.8	0.6					
	<i>Interaction AB</i>	1.3	1.3	1.2					

Note: * – control group.

At the phase of technical maturity, before harvesting the spinach plant in both researched hybrids, a smaller leaf surface was observed in the August sowing dates and was from 86.3 to 86.0 cm²/plant due to the Boa hybrid and from 106.2 to 105.4 cm² due to the Odysseus F1 hybrid.

At the technical maturity mode, plants of the Boa F1 hybrid of spinach had a larger leaf surface due to sowing in the III decade of April and II decade of May – 121.7 and 127.7 cm²/plant, respectively, and in the Odysseus F1 hybrid due to sowing in the III decade of April – 125.4 cm²/plant.

The study of the influence of the sowing date on this index proves that the surface of the leaf plate in spinach plants had bigger values at the beginning of growth in the early dates, apart from the first one.

During 2019–2021 the dynamics of the growth of the leaf surface depending on the date of sowing were studied in detail, and data were obtained and factors that could influence the increase in the leaves surface during the growing season and on the eve of harvesting, depending on the hybrid and the date of sowing in open field were analyzed.

The data received show that the leaves surface of the spinach plants in 2019–2021 at the beginning of growth was found to have a larger the leaves surface of Boa F1 spinach plants that were sown in the II decade of May – 1.72 thousand m^2/ha , which exceeded the control by 0.40 thousand m^2/ha . In the hybrid Odysseus F1, during the three early sowings, the index almost did not vary and was in the range from 1.71 to 1.73 thousand m^2/ha , which exceeded the control by 0.39–0.41 thousand m^2/ha . A smaller leaves surface was obtained in the summer sowing dates in both studied hybrids of spinach.

It was established that the August sowing dates did not contribute to obtaining a large leaves surface, and for sowing in the I and III decades of August it amounted to 1.21–1.29 thousand m^2/ha in the Boa F1 hybrid, according to the sowing date, which was lower than control by 0.11–0.03 thousand m^2/ha . In plants of the hybrid Odysseus F1, this index in August was 1.34 and 1.25 thousand m^2/ha , respectively. At the technical maturity mode, the leaf surface reached the value of 25.6 thousand m^2/ha of hybrid Boa F1 due to sowing in the I decade of April. In the hybrid Odysseus F1 during the early sowing date the leaf surface was 23.9 thousand m^2/ha , which is lower than the control by 1.7 thousand m^2/ha .

The larger leaves surface was formed by spinach hybrids Boa F1 and Odysseus F1 due to the seeds sowing in the III decade of April – 30.8–33.4 thousand m^2/ha , according to the hybrids, which exceeded the control by 5.2–7.8 thousand m^2/ha . In the second decade of May plants had a leaf surface in this phase of 31.1–32.3 thousand m^2/ha , according to the hybrids, which exceeded the control by 5.5–6.7 thousand m^2/ha . The leaves surface largely depended on the weather conditions of the year. Thus, plants grown in 2020 had the smallest leaf surface, which is explained by the unfavorable weather conditions of the year, especially the lack of moisture during the period of intensive plant growth and development.

Observation of the growth and development of plants showed that in the first period of growth, spinach grows slowly and forms an insignificant leaf mass, but during the period of technical maturity the plant significantly increases in size. In the phase of intensive growth, plants sown in the open field in the III decade of April had a larger leaves surface, regardless to the hybrid. At the time of the plant density forming the leaf surface was from 28.9 to 32.9 thousand m^2/ha .

The tendency of the leaves surface decreasing with each next sowing in the hybrid Boa F1 was observed. Thus, the leaves surface reached 33.4 thousand m^2/ha due to second sowing date in the III decade of April. It decreased to 31.1 thousand m^2/ha due to II decade of May and to 23.5 thousand m^2/ha due to II decade of June. In the late summer sowing dates, the leaf surface had a minimum value and amounted to 20.7 thousand m^2/ha due to sowing in the I decade of August, and 21.9 thousand m^2/ha due to III decade, which was caused by high temperature conditions of growth.

In spinach hybrids Boa F1 and Odysseus F1 before harvesting the green mass, the plants had the largest leaves surface after sowing in the III decade of April – 33.4–30.8 thousand m^2/ha and 31.1–32.3 thousand m^2/ha in the II decade of May.

Plants of the hybrid Boa F1 sown in the II decade of May had a smaller leaves surface on the plant – 31.1 thousand m^2/ha . In the late summer sowing dates the leaves surface of hybrids Boa F1 was minimal and was 20.7 thousand m^2/ha during sowing in the II decade of August, and 21.9 thousand m^2/ha in the III decade, which was caused by high temperature conditions.

An index of the efficiency of hybrids and growing periods of spinach in the open field is the output from one plant and from a unit of acreage. The results of the conducted research show that the hybrid and sowing date have a significant effect on the weight of the plant since the connection between the yield of commercial greens and the

weight of one plant is quite high. It has been proven that the largest weight of a spinach plant was obtained by using early sowing dates and when sowing spinach in the I decade of April. At the beginning of the rosette growth the mass of the Boa F1 over the years of research reached 2.0 g, in the III decade of April – in the II decade of May – 2.5–2.8 g.

In the hybrid *Odysseus* F1, in the I decade of April at the beginning of rosette growth, the weight of the plant reached 2.5 g. In the III decade of April and the II decade of May it reached from 2.7 to 2.8 g, respectively. Next years the weight of the plant was on the level from 2.3 to 2.8 g in accordance to sowing date.

With the use of early sowing dates for sowing of spinach in the I decade of April in the phase of technical maturity, the mass of the Boa F1 plant over the years of research reached 57.5 g, in the III decade of April – II decade of May – from 66.4 to 70.0 g. At the next years the plant weight index was smaller and amounted to 60.5–65.0 g, depending on the sowing date.

In the hybrid *Odysseus* F1 in the I decade of April in the phase of technical maturity, the weight of the plant reached 57.0 g, in the III decade of April and the II decade of May was from 62.4 to 67.3 g, respectively.

Therefore, later sowing dates in the Southern Steppe of Ukraine coincide with high temperatures during the growth of plants. It has a detrimental effect on plants, and therefore, in later sowing dates, especially in late summer, they were smaller in weight.

The main assessment of the level of influence of the hybrid and sowing date on the growth and development of spinach plants of the Boa F1 and *Odysseus* F1 is conducted based on the results of the analysis of the productivity of marketable green mass (Table 2).

According to the table data, it is possible to trace the change in yield index of spinach depending on the hybrid and date of sowing in open field and the year of research, when the weather conditions were not the same and mostly dry in 2019. Accordingly, the yield analysis shows that it was lower in 2019 by 19.6–22.5 t/ha, which is explained by unfavorable weather conditions during the growing season.

The years 2020 and 2021 were characterized by more favorable conditions, in which the yield of marketable green mass was higher and during the early sowing dates it reached the level of 23.2–24.7 t/ha in spinach of the hybrid Boa F1 and 23.6–25.5 t/ha in the hybrid *Odysseus* F1. It was received significant yield growth at level from 3.3 to 6.0 t/ha. At the next sowing dates in the II decade of June and I and II decades of August, the productivity of the hybrid Boa F1 was 21.5–22.7 t/ha and hybrid *Odysseus* F1 20.2–22.8 t/ha respectively.

On average, over the years of research, the highest yield, depending on the hybrid, was obtained for sowing in the III decade of April and the II decade of May in the hybrids Boa F1 – from 22.9 to 23.0 t/ha, in the hybrid *Odysseus* F1 – from 23.3 to 23.9 t/ha, which is higher than the control by 3.3–4.2 t/ha.

A low yield was obtained from plants sown in the I decade of April and in summertime. So, when sowing spinach hybrids Boa F1 and *Odysseus* F1 in the I decade of April, the yield was only 18.9 and 19.6 t/ha, respectively, according to the studied variety. In the II decade of June, the yield of both hybrids decreased to the level of 21.8–22.1 t/ha, which was higher than the control by 2.1–2.4 t/ha. During the late summer sowing dates in August, the yield of commercial greens was 20.6–21.7 t/ha, which is higher than the control by 0.9–2.1 t/ha.

As a result of the conducted research, there was a need to establish important characteristics for spinach, which was conducted on the basis of calculations of correlations between biometric and productive indexes.

Table 2

The yield of spinach depending on the hybrid and sowing date, t/ha

hybrid	Sowing date	2019	2020	2021	2019–2021	± to control
Boa F1	April I decade*	19.6	20.5	18.9	19.7	0
	April III decade	20.9	24.7	23.3	23.0	3.3
	May II decade	21.7	23.8	23.2	22.9	3.2
	June II decade	21.3	22.2	21.9	21.8	2.1
	August I decade	19.9	21.8	21.5	21.1	1.4
	August III decade	20.6	22.7	21.9	21.7	2.1
Odysseus F1.	April I decade	19.8	22.8	19.6	20.7	1.1
	April III decade	22.5	25.5	23.6	23.9	4.2
	May II decade	20.4	24.7	24.9	23.3	3.7
	June II decade	20.8	22.8	22.7	22.1	2.4
	August I decade	19.9	20.2	21.6	20.6	0.9
	August III decade	20.6	21.6	22.8	21.7	2.0
<i>LSD</i> ₀₅	<i>Factor A</i>	0.3	0.4	0.2		
	<i>Factor B</i>	0.7	0.6	0.5		
	<i>Interaction AB</i>	1.4	1.3	1.1		

Note: * – control group.

It was found that there is a strong positive correlation between plant weight and the number of leaves ($r = 0.98$), the yield of spinach and the plant weight ($r = 0.91$). In parallel with the study of productivity, an assessment of the quality of products of spinach hybrids was conducted according to chemical parameters in commercial products before harvesting, depending on the hybrid and date of sowing in open field (Table 3).

The analysis of the obtained data showed that the hybrid and sowing date influenced the main indexes of the chemical composition of the green mass of the spinach hybrids Boa F1 and Odysseus F1. The higher content of chlorophyll (a+b) – 0.445 ml/l was observed in plants that were sown in the III decade of April. The content of nitrates in spinach plants was at a low level in the range from 48 to 55 mg/kg and did not exceed the MAC for green leaves of spinach.

The brix in spinach leaves of hybrids Boa F1 and Odysseus F1 was at the level of 5.1–6.8% and was higher than sowing in the III decade of April and II decade of May – 6.4–6.8%, which exceeded the control by 0.3–0.7%. The mass share of sugars, depending on the hybrid and date of sowing in open field, fluctuated between 2.1–2.4% and was almost at the same level. Plants grown during the early sowing dates were characterized by a higher sugar content. The content of vitamin C was in the range of 52–70 mg/100 g,

depending on the date of sowing. Moreover, the vitamin C content was dominated by the sowing dates in the I and III decade of April – 50–60 mg/100 g and II decade of May – 58–70 mg/100 g.

Table 3
Indexes of the chemical composition of spinach in different periods of growth and development depending on the hybrid and date of sowing (2019–2021)

hybrid	Sowing date	Brix, %	Chlorophyll (a+b), ml/l	Nitrates, mg/kg	Sugar, %	Vitamin C, mg/100 g
Boa F1	April I decade*	6.3	0.449	51	2.2	55
	April III decade	6.7	0.449	52	2.3	61
	May II decade	6.4	0.442	49	2.3	59
	June II decade	6.4	0.429	53	2.2	55
	August I decade	5.4	0.429	52	2.1	54
	August III decade	5.8	0.408	54	2.1	54
Odysseus F1.	April I decade	6.1	0.440	47	2.1	53
	April III decade	6.2	0.442	51	2.2	57
	May II decade	5.2	0.421	52	2.3	59
	June II decade	5.3	0.422	52	2.2	55
	August I decade	5.3	0.420	52	2.1	54
	August III decade	5.5	0.421	53	2.1	55

Note: * – control group.

So, the date of sowing had a significant influence on the main chemical parameters of the spinach hybrids Boa F1 and Odysseus F1, and in the leaves, the higher parameters were noted for the dates of sowing in the III decade of April and the II decade of May, where the brix reached the level of 6.4–6.8 %, sugars content – 2.3–2.4 %, vitamin C content – 58–70 mg/100 g.

Conclusions and suggestions. The study of the influence of the sowing date on the leaves number revealed that when sowing of spinach hybrids Boa F1 and Odysseus F1 in the third decade of April and the second decade of May formed a higher number of leaves. The hybrid Boa F1 had 18–19 pcs/plant and hybrid Odysseus F1 – 18–20 pcs/plant. More favorable conditions in 2020 made it possible to obtain an additional 2–4 leaves per plant.

Spinach plants of both hybrids had a larger leaf surface at the beginning of rosette growth during the early sowing dates – 114.2–127.7 cm²/plant. Plants sown in August had a smaller leaf surface – 86.0–106.2 cm²/plant.

Depending on the hybrid, the highest yield of marketable green mass was obtained for sowing in the III decade of April and the II decade of May in the hybrid Boa F1 – 22.9–23.0 t/ha, in the hybrid Odysseus F1 – 23.3–23.9 t/ha, which is higher than the control by 3.2–4.2 t/ha.

The LSD_{0.5} in quantitative expression according to factors A and B for spinach yield was 0.2–0.7, which indicates reliable values between their reps and variants.

It has been established that the soil and climatic conditions of Ukraine are suitable for sowing spinach in six sowing dates. The conveyor growing will ensure an uninterrupted supply of green products from the third decade of April to the end of September. In some years until mid-October. It will partially solve the problem of overcoming seasonality in the consumption of fresh green vegetables.

The date of sowing had a significant influence on the main chemical parameters of spinach hybrid. The higher indexes were noted for the dates of sowing in the III decade of April and the II decade of May, where the brix reached the level of 6.4–6.8 %, sugars content – 2.3–2.4 %, vitamin C content – 58–70 mg/100 g.

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