

**DEVELOPMENT OF SOME ELEMENTS OF THE TECHNOLOGY FOR GROWING
LEEK (*ALLIUM PORRUM* L.) IN THE SOIL AND CLIMATIC CONDITIONS OF THE
REPUBLIC OF KARAKALPAKSTAN**

Asatov Shukhrat Ismatovich

Tashkent State Agrarian University, Professor; <https://orcid.org/0009-0002-9854-805X>

Nizanov Janibek Khummetillovich

Corresponding Author, Doctoral student of Institute of Agriculture and Agrotechnologies of
Karakalpakstan, Nukus, Uzbekistan; <https://orcid.org/0009-0006-4020-8684>

Abstract. This article presents the results of research on the origin of leeks, major countries engaged in their cultivation, morpho-biological characteristics of the plant, as well as some features of cultivation technology. Field experiments were conducted on growing leeks from 20, 30, 40, and 50-day-old seedlings in moderately saline soils, observing their growth and development stages, and yield. The largest leaf sizes were found in areas planted with older seedlings. Specifically, 50-day-old leek plants formed leaves 18-22 cm longer than those of other age groups (20, 30, and 40-day-old plants). In terms of the number of leaves per plant, those grown from 50-day-old seedlings had 2-4 more leaves compared to plants of other ages. The "white pseudostems" of leeks are consumed fresh or in processed form. The size of the formed white pseudostems on the plants measured 11-18 cm. The findings revealed that the highest yields (21.8-24.7) were obtained from areas planted with 40- and 50-day-old seedlings. This article also presents the results of experiments on the selection of early-ripening and high-yielding varieties of leeks, with the highest yield during 2023-2024 being 21.4 t/ha for the Karantanskiy variety. Biochemical analyses conducted revealed that while the content of sugar, dry matter, protein, essential oils, and fiber in leeks is similar to that of onions and garlic, leeks were found to be superior in terms of vitamins A, B1, B2, C, and mineral salts (Ca, P).

Keywords: leek, seeds, seedling age, germination rate, number of leaves, plant weight, yield, nitrates.

1 Introduction

In recent years, the increasing world population, ongoing global climate changes, as well as limited land and water resources have brought the issue of food security to the forefront. In such conditions, the cultivation of leek products, which contain vitamins essential for human health, is considered one of the important and urgent tasks facing the vegetable growing sector.

At a video conference meeting chaired by the President of the Republic of Uzbekistan on June 30, 2025, dedicated to "Increasing the export of fruits, vegetables, and food products," the importance of growing vegetables with high nutritional value and increasing their export volumes was emphasized.

Currently, soil salinization causes serious damage to the yield of agricultural crops. Almost 91% of the soils of the Republic of Karakalpakstan have varying degrees of salinity, and it is advisable to identify and plant vegetables that are more resistant to soil salinity.

Leek (*Allium porrum* L.) is a biennial plant originating from countries surrounding the Mediterranean Sea. Its high nutritional value and ease of cultivation are contributing to the rapid popularization of this crop. Currently, leeks are grown on 3,600 hectares in Belgium and England. In countries located in Central America, leeks are considered the second most cultivated type of onion after garlic. In France and the Netherlands, leek is the most consumed type of onion by the population, the consumption per capita in these countries is 4-6 kg [14]; [15].

The largest producers of leeks in Europe are France (225 thousand tons), Belgium (85-90 thousand tons), the Netherlands (60-70 thousand tons), England and Spain (50-60 thousand tons) [17].

According to Sh.M. Albuquerque and A.M. Shenoy [1], leeks are widely cultivated in Western European countries, especially in France and Belgium.

Many scientists report that this crop has high nutritional and medicinal properties, containing a large amount of fiber, calcium, phosphorus salts, as well as vitamins A, B1, B2, C [2]; [3]; [16]; [18].

Due to the high content of mineral salts, especially potassium (250 mg/100 g of wet weight), it has diuretic properties and is therefore recommended for people with kidney stones. They are also very beneficial for atherosclerosis, obesity, gout, and rheumatism.

In Asia, the largest producers are Indonesia (638.7 thousand tons) and South Korea (148.1 thousand tons).

The reason for the widespread popularity of leeks in countries around the world is the high content of biologically active substances in their composition [16].

In Uzbekistan, including Karakalpakstan, leeks are considered a rare vegetable. Currently, leeks are grown mainly by "amateur" vegetable growers in private household plots [4].

There are insufficient scientifically based recommendations for the cultivation of leeks with high nutritional and medicinal properties in the republic. Only one Lincoln F1 hybrid of leek is included in the State Register of Agricultural Crops Recommended for Sowing in the Territory of the Republic of Uzbekistan [5]; [12].

Based on the data presented, the development of effective methods for growing leeks, the selection of varieties adapted to the soil and climatic conditions of the Republic, and the development of scientifically based recommendations is one of the urgent tasks of today.

2 Materials and methods

Field experiments were conducted in 2023-2024 at the experimental farm of the Karakalpak Institute of Agriculture and Agrotechnologies in the Nukus district.

Climatic conditions. The climatic conditions of this region are characterized by dry, hot summers and cold winters with sharp continental variability. The duration of sunlight is 2800-3000 hours per year, 365-400 hours in summer, and 90-130 hours in winter [8].

The average annual temperature is +12.5°C, the average temperature in January is -4°C, in July +28°C. In this region, the absolute minimum during the year is -28°C, and the absolute maximum is +45°C. (Table 1)

Table 1. Meteorological conditions of the Nukus district (2023-2024).

Months	Air temperature, °C			Soil at a depth of 10 cm, °C			Amount of precipitation, mm			Relative humidity of air, %		
	2023	2024	Average long-term	2023	2024	Average long-term	2023	2024	Average long-term	2023	2024	Average long-term
February	1,3	4,6	0	-	-	-	9,8	4,1	14,1	65	67	69
March	5,7	5,6	4	9,1	8,1	9,8	15	11,2	11,1	59	60	53
April	17,8	19,2	14,5	17,7	18,7	15,9	21	19,1	25,9	32	42	43
May	26	21,7	23,2	26,2	23,3	25,4	2	58,1	11	23	46	33
June	30	29	27,8	31,8	30,1	30,2	8	2,4	1,8	25	26	26
July	31,3	30	31,2	34	32,5	33,7	0,4	0	3,9	24,6	27	28
August	28,8	26,8	26,4	31,6	30,2	29,9	0	0,4	2,9	26	28	33
September	20,7	21,5	19,4	24,1	24	23,5	2,4	7,7	0,3	28	31	34
October	9,2	12,4	12,1	4,7	16,8	16	2,6	4,1	10,6	41	43	43

The frost-free period lasts 205 days throughout the year. Annual rainfall is 100 mm with March as the wettest month. The main part of precipitation falls in the winter-spring months (Fig 1).

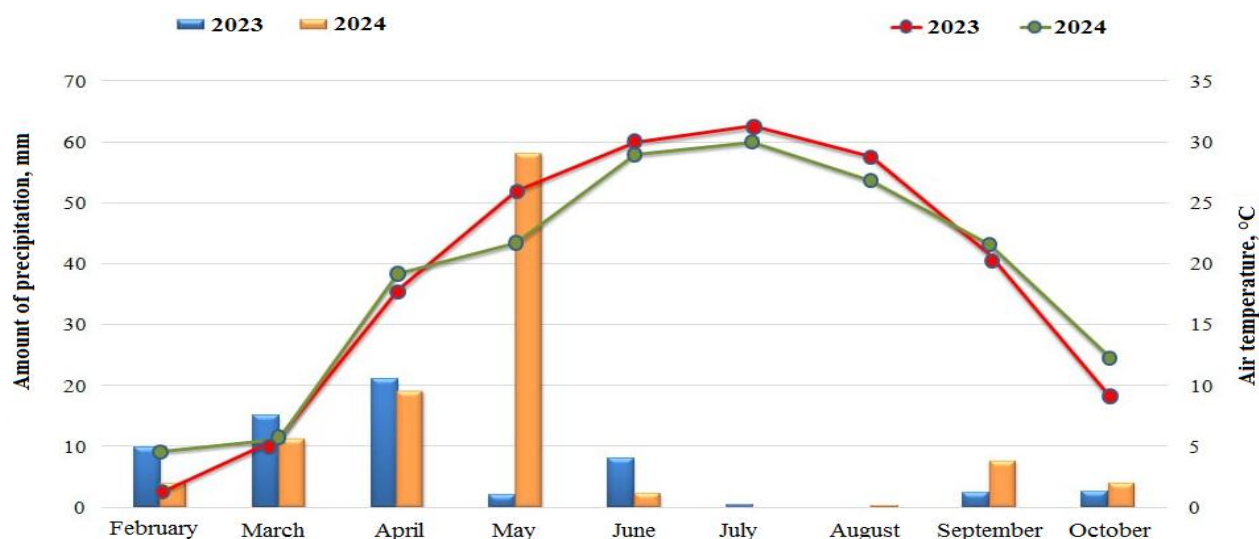


Figure 1. Air temperature and precipitation, data from the Nukus meteorological station (2023-2024).

The amount of precipitation in February-March 2023 was higher than in the same period in 2024, but in May 2024, the amount of precipitation was significantly higher than in May 2023.

Soil samples were taken and analyzed in the plough layer (10-30 cm) and under-plow horizons (31-50 cm) of the experimental plot. According to the analysis results, the humus content in soils at a depth of 0-30 cm was 0.42 mg/kg, and in the lower horizon (31-50 cm) - 0.38 mg/kg. Gross nitrogen was 0.7433-0.4345 mg/kg, gross phosphorus 98.0-37.79 mg/kg, and gross potassium 456-458 mg/kg, respectively (Table 2).

Table 2. Agrochemical analysis of soils of the experimental plot (2023-2024).

Layer depth, cm.	Humus %	Amount of mobile substances, mg/kg		
		N	P ₂ O ₅	K ₂ O
0-30	0,42	0,7433	98,0	456
31-50	0,38	0,4345	37,79	458

The humus content is very low, low in total and mobile phosphorus, and medium in exchangeable potassium.

The soils of the experimental plot are moderately saline chloride-sulfate, and due to salinity along the soil horizons, secondary salinity can be observed (Table 3).

Table 3. Salt content in the soils of the experimental field (2023-2024).

Layer depth, cm.	Dry residue	HCO ₃	Cl ⁻	SO ₄ ⁻	Ca ⁺⁺	Mg ⁺⁺	Na ⁺⁺	Salinization		PH
	%							type	level	

0-30	2,134	0,1464	0,1775	0,96	0,1002	0,0060	0,0736	X-C	Modera tely saline	6,4
31-50	5,289	0,1586	0,1065	0,408	0,2004	0,0486	0,0782	X-C	Modera tely saline	6,1

The development of the above topic was carried out by conducting field and laboratory experiments. Field experiments on determining the age of seedlings during the cultivation of leeks were conducted with the Karantansky variety.

Karantanskiy is a late-ripening, high-yielding variety with a cylindrical stem that ripens 180 days after planting. Average yield 213-258 c/ha. The color of the leaves is dark green, covered with strong wax, medium height, medium density, taste is semi-sharp, tolerates frosts down to -5-7°C.

The experiments were repeated 4 times on an area of 7 m², with a furrow length of 5 m. 20, 30, 40, and 50-day-old leek seedlings were planted in the 3rd decade of March according to the 60x10 cm scheme. Field experiments were conducted with phenological observations and biometric measurements. In conducting the research, the methodological manuals of B.Zh. Azimov, B.B. Azimov "Methods of Conducting Experiments in Vegetable Growing, Melon Growing, and Potato Growing" (2002) [6], V.F. Belik "Methods of Field Experiments in Vegetable Growing and Melon Growing" (1992) [7], J.S. Sattarov "Practicum on Agrochemistry", "Methods of Agrochemical Analyses" [10] were used. Statistical analysis of the data was carried out using the Microsoft Excel program based on the dispersion method of B.A. Dospekhov (1985) [9].

In the conducted laboratory experiments, the germination rate of leek seeds was determined by soaking them in 0.1%, 0.3%, 0.5%, and 1% NaCl solutions (Figure 2).



Figure 2. Determination of seed germination under laboratory conditions

Leek seeds were calibrated before sowing, and their measurements showed dimensions of 2.5 mm in length, 1.5 mm in width, with 1000 seeds weighing 3.3 grams (Figure 3).

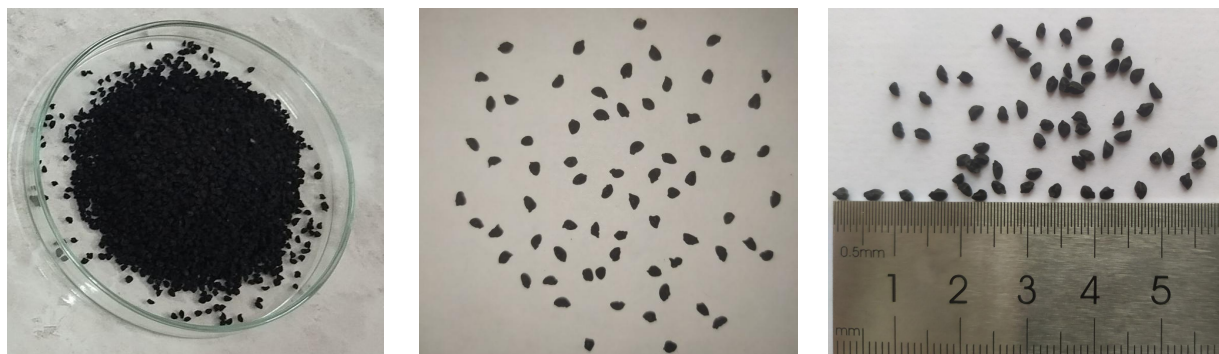


Figure 3. Leek seeds.

The seeds were planted in cassettes with dimensions of 4x4 cm. The substrate used consisted of 50% biohumus, 40% field soil, and 10% rice husks (Figure 4).

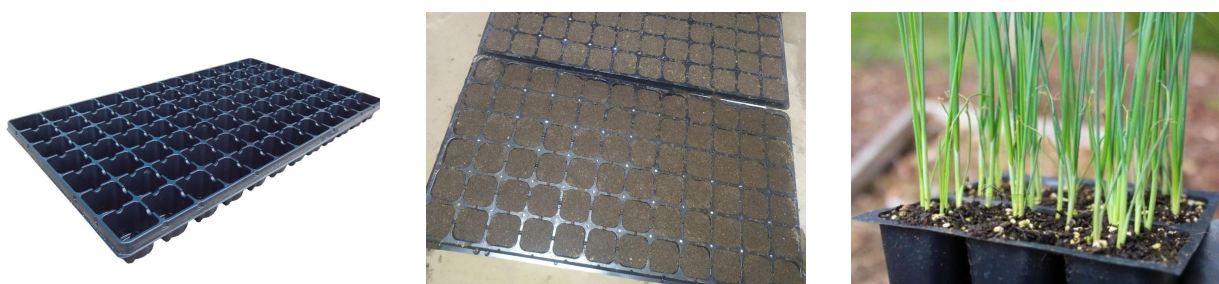


Figure 4. Used cassette and substrates.

3 Results and Discussion

Impact of Leek Seedling Age on Growth, Development, and Yield

It is known that vegetable crops can be grown from both seeds and seedlings. When sowing crops from seeds, the costs for seeds and plant care are high.

I.E.Tigunova (2015) [11] recommends sowing its seeds in the foothill regions of Crimea in the first 10 days of March for the cultivation of white pseudostems of leeks with a diameter of 25.5 mm. In addition, the growing season of plants increases, and the quantity of marketable products decreases. "Advancement" in seedling cultivation allows for obtaining early and high yields.

In the soil and climatic conditions of the Republic of Karakalpakstan, one of the urgent problems is the determination of the age of seedlings and the development of cultivation technology. Taking this into account, we set ourselves the goal of conducting research work in 2023-2024 in order to determine the influence of growing leeks from seedlings on the growth, development, and yield of plants.

Field experiments were conducted in 2023-2024 in the experimental field of the Karakalpak Institute of Agriculture and Agrotechnologies, located in the Nukus district.

In the studies, 4-year-old seedlings of the Karantansky variety of leek were planted. Field experiments were conducted in four repetitions on furrows with a length of 5m, the calculated area was 7 m². In the experiments, the following observations and measurements were carried

out: phenological, biometric observations, observations to determine diseases and pests, as well as the amount of yield.

Usually, early vegetable seedlings are prepared in greenhouses for 45-60 days. In our field experiments, the influence of 20, 30, 40, and 50-day-old seedlings of leek, sown at early dates, on the growth, development, and yield of plants was experimentally tested.

In terms of the number and size of leaves, 40-50-day-old seedlings of sown leek prevailed over 30-40-day-old seedlings (Table 4). The height of the grown seedlings in 40-50-day-old seedlings was also 9.8-14 cm longer than in seedlings of other ages.

Table 4. Quality indicators of seedlings (2023-2024).

No.	Seedling ages, days	Number of leaves, pcs	Seedling height, cm.	Diameter of the white false stem, cm.
1	20	2	9,8	0,2
2	30	2	14,0	0,3
3	40	4	18,5	0,5
4	50	4	23,8	0,6

The age of the planted seedlings influences the growth and development of the leek. Biometric observations revealed that the older the seedlings, the greater the number and size of their leaves. It should be noted that in early periods, it was observed that moderate temperatures, high soil moisture, and good adaptation to a permanent location were observed in all experimental seedling ages. The largest leaf sizes were determined in the areas where relatively older seedlings were planted. In particular, on 50-day-old plants of the onion poreum, leaves 18-22 cm longer than at other ages (20, 30 and 40 days) were formed. In terms of the number of leaves on plants, plants planted from 50-day-old seedlings were 2-4 pieces higher than plants of other ages.

The "white pseudostems" of the leek are consumed in fresh or processed form. The size of the formed false white stems on the plants was 11-18 cm. The largest "white pseudostems" were formed at the age of 50 days of seedlings, and their size was 18.8 cm (Table 5).

Table 5. Influence of leek seedlings of different ages on the number of leaves on plants and their size (2023-2024).

No.	Seedling ages, days	Number of leaves formed on plants, pcs.	Largest leaf length, cm		Length of the white pseudostem, cm
			2023	2024	
1	20	11	63	61	11,9
2	30	12	68	71	13,2
3	40	15	72	70	16,5
4	50	17	85	89	18,8

The length of the white pseudostem obtained from the leeks of this variety largely depends on the method of "sanding" the plants. However, their formation certainly depends on

the number of leaves on the plant.

The age of the tested seedlings also affects the average weight of one plant. The average weight of plants grown from 20-day-old seedlings was 73 grams or 31.6% lighter than that of 50-day-old seedlings.

Among the tested seedling ages, the highest yield was formed in fields planted with 50-day-old seedlings.

The average yield during the 2023-2024 experiment showed that the highest yield was 24.7 t/ha in 50-day-old seedlings, and the lowest yield was 18.4 t/ha in 20-day-old seedlings (Table 6). In the fields sown with 30- and 40-day-old seedlings, a yield of 19.3-21.8 t/ha was formed.

Table 6. Influence of leek seedlings of different ages on yield (2023-2024).

No.	Seedling ages, days	Average weight of one plant, g	Yield, t/ha		
			2023	2024	Average yield, t/ha. (2023-2024)
1	20	231	18,6	18,3	18,4
2	30	259	19,2	19,5	19,3
3	40	287	21,7	22,0	21,8
4	50	304	24,5	24,8	24,7

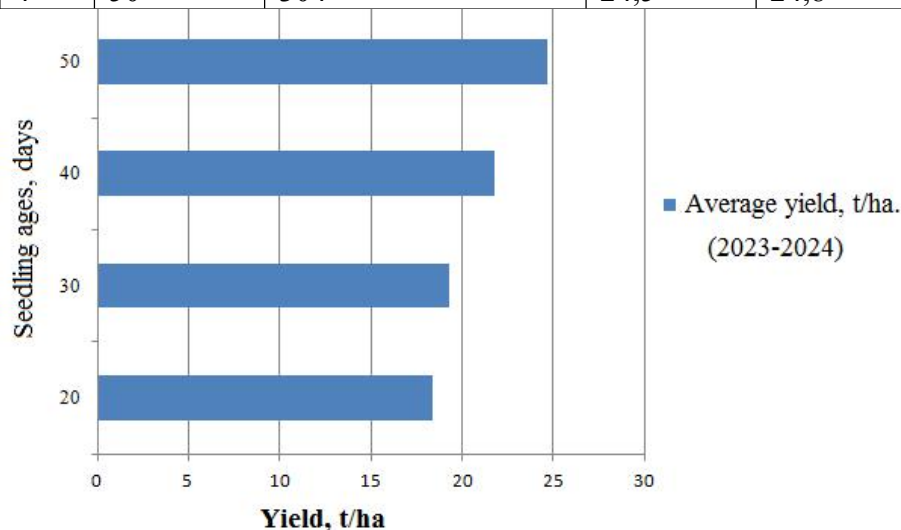


Figure 5. Yield by Age of Seedlings

Selection of early-ripening and high-yielding varieties of leek

The following results were obtained from the research conducted during 2023-2024 on the selection of leek varieties adapted to the soil and climatic conditions of the Republic of Karakalpakstan.

Phenological observations of leek varieties in early sowing showed that when planting seedlings, it takes 120-180 days for white false stems to fully form. The earliest formation of white false stems was observed in the Karantanskiy variety by 85-90 days, which is 5-10 days

earlier than in other varieties.

Biometric measurements of the plant height of leek variety samples showed that in the standard Lincoln F1 hybrid, the plant height was 76.5 cm, while plants with heights of 4.1-10.9 and 14.5 cm were formed in the Kolambus (80.6 cm), KK-101 (87.4 cm), and Karantansky (91.0 cm) varieties. It was also established that plants 1.4 cm shorter than the standard were formed in the Pobeditel variety (75.1 cm) (Table 7).

Table 7. Indicators of biometric measurements of leek variety samples, (2023-2024).

No.	Varieties	Plant height (cm.)	White false stem	
			Lengths (cm.)	Diameter (cm.)
1	Lincoln F1 (st.)	76,5	17,2	3,7
2	Kolambus	80,6	14,0	4,1
3	Karantansky	91,0	20,3	4,3
4	KK-101	87,4	18,5	4,0
5	Pobeditel	75,1	14,9	3,5

When comparing the length of the white stems of the tested leek variety samples in our experiments, it was found that in the standard Lincoln F1 hybrid it was 17.2 cm, and compared to this, 1.3-3.1 cm longer white stems were formed in the KK-101 (18.5 cm.) and Karantansky (20.3 cm.) varieties. Short white false stems of 2.3-3.2 cm compared to the standard were formed in the Pobeditel (14.9 cm.) and Kolambus (14.0 cm.) varieties.

The following data were obtained from biometric measurements of white soybean stem diameter of the tested variety samples within the framework of the research. According to this, in the standard Lincoln F1 hybrid of leek, the diameter of the white soybean stem was 3.7 cm. White stems with a larger diameter of 0.3-0.4 and 0.6 cm were formed in the KK-101 (4.0 cm), Kolambus (4.1 cm) and Karantansky (4.3 cm) varieties, and conversely, white stems with a smaller diameter of 0.2 cm were formed in the Pobeditel (3.5 cm) variety.

Measurements conducted to determine the yield amount showed that the weight of a single white false stem in the standard Lincoln F1 hybrid was 144.8 grams. Compared to this variety, white false stems weighing 27-35.3 g more were observed in the KK-101 (171.8 g) and Karantansky (180.1 g) varieties, and conversely, white false stems weighing 3.3-9.8 g less were found in the Kolambus (141.5 g) and Pobeditel (135.0 g) variety samples (Table 8).

Table 8. Yield of leek variety samples, (2023-2024).

No.	Varieties	Average weight of one plant, g.	Average per plant		Total yield t/ha
			leaf weight, g.	white false stem weight, g.	
1	Lincoln F1 (st.)	282,4	137,6	144,8	23,9
2	Kolambus	278,7	137,2	141,5	23,2
3	Karantansky	321,8	141,7	180,1	26,7
4	KK-101	314,2	142,4	171,8	26,3

5	Pobeditel	259,7	124,7	135,0	26,0
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According to the results of measuring the weight of leaves on one plant of different variety samples tested in our experiments, the standard Lincoln F1 hybrid had 137.6 grams, compared to which 4.1-4.8 grams more weighted leaves were formed in the Karantansky (141.7 grams) and KK-101 (142.4 grams) varieties, and conversely, 0.4-12.9 grams less weighted leaves were counted in the Kolambus (137.2 grams) and Pobeditel (124.7 grams) varieties.

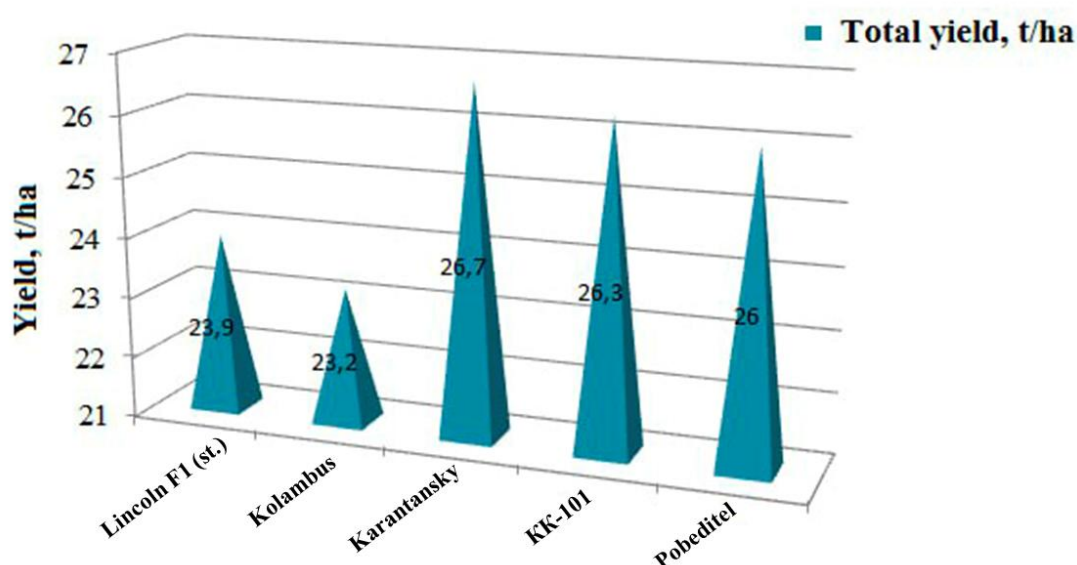


Figure 6. Total yield by variety

Analysis of the composition of onion varieties showed that, although the content of sugars, dry matter, essential oils, and fiber in leeks is similar to that of onions and garlic, it accumulates vitamins A, B1, B2, C, and mineral salts Ca, P. (Table 9).

Table 9. Chemical composition of onion species

Onion species	Included in %					Vitamins, mg				Mineral salts, mg	
	sugar	Dry matter	Protein	Essential oil	Fiber	A	B ₁	B ₂	C	Ca	P
Onion: in a green leaf in the onion head	1,5 6-12	9-12 10- 20	1,3 2	0,1 0,5	0,9 0,7	- 0,03	- 0,05	- ,02	- 7,4	- 23	- 29

Garlic onion	26	35	6,8	0,06	0,8	0,05	0,08	0,08	10	18 0	100
leek (in the false stem)	10	13,5	1,8	0,1	0,9	0,3	0,1	0,04	35	.87	58

4 Conclusions

Leek (*Allium porrum* L.) surpasses other types of onions in its richness in vitamins and minerals and, accordingly, is grown in large areas in various countries of the world. The largest leaf sizes in the tested seedling ages were determined in the areas planted with older seedlings. 50-day-old plants of the leek bulb formed leaves 18-22 cm longer than those of other ages (20, 30, and 40 days). In terms of the number of leaves on plants, plants planted from 50-day-old seedlings were 2-4 units higher than plants of other ages.

This type of vegetable can be grown not only from seeds, but also from seedlings for early harvesting. Tested 20; 30; Of the 40 and 50-day-old seedlings, the highest yield (21.8-24.7 t/ha) was obtained with 40 and 50-day-old seedlings.

Among 5 tested varieties and hybrids (Karantansky, KK-101, Pobeditel, Kolambus, Lincoln F1 st.), the highest yield was formed in the Karantansky variety (26.7 t/ha). In this variety, the weight of the marketable stem "White False" was 180.1 grams, and its length was 20.3 cm. Although the amount of sugar, dry matter, essential oils, and fiber in the composition of leek varieties is close to the composition of onions and garlic, it accumulates a large amount of vitamins A, B1, B2, C, mineral salts Ca, P.

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