Scientific and practical fundamentals of growing cabbage (Brassica capitata lizg.) in Uzbekistan

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Abstract. At present, scientific research is underway to further develop vegetable growing in the secondary crop, in particular to further increase the yield and quality of white cabbage, to select a system of planting time-sowing scheme that maximizes the biological productivity of varieties, and to apply the most optimal standards of fertilization and irrigation. In this regard, the urgent task remains to determine the optimal varieties of cabbage that can be grown in repeated crops, their optimal planting scheme, timing, development and implementation of optimal standards for each variety of mineral fertilizers and irrigation, and its solution is large-scale throughout the country. Besides that a number of problematic issues are addressed, which could allow to get high and high-quality harvest of white cabbage in repeated sowing in grain-free areas.

1. Introduction

Vegetable crops, especially white cabbage, are grown as a main crop in large areas in Southern Europe, Central and South Asia, North and South America, Australia and other regions. Today, this vegetable crop is grown on more than 2.82 million hectares worldwide, with an average yield of 29.4 tons per hectare and a gross yield of 82.8 million tons. In order to meet the demand of the population for this product, it is important for agricultural producers to improve the technology of growing this crop as a secondary crop, including optimal planting times, planting schemes, plant nutrition, fertilization and irrigation standards, as well as selection of commercial and high-yielding varieties and hybrids [1, 2, 3].

Research on the creation and selection of high-yielding varieties of cabbage suitable for cultivation in different periods and especially in repeated crops, improvement and mechanization of agrotechnical measures to increase the yield of cabbage is carried out in leading research centers and institutions around the world, including more than 40 vegetable research institutions. European Vegetable Research Institutes Network (EuVRIN), Beijing Vegetable Research Center (BVRC, China), Research Institute of Vegetable Crops (Poland), All-Russian Vegetable Research Institute, Vegetable Breeding and Seed Research Institute and Federal Vegetable Research Center (Russia), Kazakhstan Scientific Research Institute of Potato and Vegetable Growing (KazSRIPVG), Research Institute of Vegetables and Potato (Uzbekistan) [4, 5, 6].

The following scientific results have been achieved on the basis of world research on the creation and selection of high-yielding, conservative and reproducible varieties, the development of agrotechnical elements for the production of high-quality cabbage [7, 8]: Hundreds of varieties of cabbage for early, middle and late sowing (European vegetable research Institutes Network); the technology of
growing cabbage seedlings under film, followed by direct sowing of seedlings and seeds up to 4 times a season (Beijing vegetable research center, China); varieties suitable for growing cabbage in the second crop were selected (Kazakhstan Scientific Research Institute of Potato and Vegetable Growing); Promising varieties of cabbage Sharkiya-2, Termez-2500, ‘Saraton’, and many others can be grown at different times (Research Institute of Vegetables and Melons and Potatoes, Uzbekistan) [9, 10].

Today, in order to further increase the volume and improve the quality of cabbage production in foreign countries, which are leaders in the cultivation of white cabbage, scientific research is being conducted in the following priority areas: creation of ultra-early, early, middle and late varieties of cabbage improvement of agro-technical system, use as a secondary and intermediate crop, which allows rational use of arable land [11].

Many regional and international scientists have developed scientific principles for the selection of varieties for the cultivation of white cabbage, optimal planting schemes, planting times and plant placement thickness, seedling cultivation, seed cultivation and plant care technologies in the main area. In particular, various recommendations were given for the selection of varieties suitable for the soil-climatic conditions of certain regions for evening cultivation, planting plants in convenient schemes and terms, the use of varieties-specific agrotechnics, irrigation, feeding and others [7, 9, 12, 13, 14, 15].

At present, plenty of studies are underway to further develop vegetable growing in the secondary crop, in particular to further increase the yield and quality of white cabbage, to select a system of planting time-sowing scheme that maximizes the biological productivity of varieties, to apply the most optimal standards of fertilization and irrigation [4, 7, 9]. In this regard, the urgent task remains to determine the optimal varieties of cabbage that can be grown in repeated crops, their optimal planting scheme, timing, development and implementation of optimal standards for each variety of mineral fertilizers and irrigation, and its solution is large-scale throughout Uzbekistan [1, 11].

Considering all the above, the main objectives and tasks of this paper are as following:

- to develop effective elements of the technology of cultivation of late varieties of white cabbage as a secondary crop in the grain-free areas;
- to select white cabbage varieties for re-cultivation in the evening;
- to identify suitable planting schemes and planting times for the cultivation of white cabbage in the repeated sowing in the evening;
- to establish optimal standards of feeding and irrigation procedures for the late cultivation of white cabbage; and,
- to determine the correlation (B, %) and correlation coefficient (r) of the interdependence of phenological, biometric, morphological and economic indicators of the plant on the variety, sowing scheme, sowing period, feeding and irrigation norms.

2. Materials and methods

The object of study is the regionalized varieties of white cabbage Sharkiya-2, ‘Saraton’, hybrids Geant F1 and W61–19 F1; planting schemes, planting times, as well as fertilization and irrigation standards served.

The study of morpho-biological features of the growth and development of white cabbage grown in the evening in the conditions of ancient irrigated meadow-gray soils of Tashkent province; is explained by the determination of the coefficients of variation (B, %) and correlation (r) of the elements of development and yield, depending on the variety used, planting scheme, planting time, fertilization and irrigation standards.

Statistical analysis of the results of the study was carried out in computer programs "Excel 2010" and "Statistica 7.0 for Windows" with a confidence interval of 95%, using the variance method "Methodology of field experience" from B.A. Dospekhov [1, 11]. As the scientific novelties, optimal sowing schemes and sowing dates have been identified, which provide the highest and highest quality
yield of white cabbage when grown as a secondary crop in areas vacated by winter grain crops and others as following:

- developed feeding and irrigation standards that allow to maximize the yield of white cabbage in the cultivation of secondary crops in the evening;

- variation of interdependence of phenological, biometric, morphological and economic indicators of selected promising varieties on the variety, planting scheme, sowing period, feeding and irrigation norms (B,%) and the correlation coefficient (r) were determined.

3. Results and Discussion

Tashkent province in the cultivation of white cabbage in the fallow lands in the grassland-gray soil conditions: white cabbage in the repeated sowing of varieties Sharkiya-2, ‘Saraton’ 70x50 cm, 90x30 cm and June 15-30 of the year. When grown in the period of \( N_{200}P_{150}K_{100} \) \(-\) \( N_{250}P_{150}K_{100} \) kg per hectare, an additional yield of 10-30% was achieved.

When the Sharkiya-2 variety and Geant F1 hybrid were planted in June 15 in 70x50 and 90x30 cm schemes, the yield was 10–19% higher than in the control variant (June 30). As productivity increased, the cost of production decreased from 18.0 to 13.2%. The rate of return was 41-58%.

When the soil moisture (Limited Field Moisture Capacity - LFMC) before irrigation in the variety ‘Saraton’ and the hybrid W61-19 F1 is not reduced to 80-80%, when mineral fertilizers are applied at the rate of \( N_{150}P_{150}K_{100} \) kg/ha, control 70-70% irrigation regime, yield relative to the feeding rate \( N_{150}P_{150}K_{100} \) kg/ha 23-26% higher. At the same time, the cost of production decreased from 181,000 UZS to 155,000 UZS or 16.8%. The rate of return was 51-61%.

3.1 Selection of optimal planting schemes for the cultivation of white cabbage in the secondary crop

The results of the study were conducted to determine the most optimal planting scheme that would allow maximizing the yield of white cabbage grown in the second crop rotation. Biometric calculations showed that the number of free leaves in the plant in white cabbage varieties was 94.3-105.0% in the Sharkiya-2 variety according to planting schemes; In the ‘Saraton’ variety, it was in the range of 91.0-100.0% compared to the control option from the planting scheme of 70x30 cm to 90x40 cm, the free leaf weight on the plant increased by 22-24.2% in both varieties.

Leaf length and leaf width dimensions were 106.4% in the 70x50 cm scheme in the Sharkiya-2 variety compared to the control, while the variety ‘Saraton’ was 105.3%. Outer core thickness and root weight were not significantly affected and ranged between 7.4–4.9%.

![Figure1. Yield of cabbage varieties depending on the sowing scheme (2007-2010)](image-url)
The effect of planting schemes on free leaf weight and root weight was strong. In 70x50 cm scheme, it was 119.8-142.5% in the Sharkiya-2 variety compared to the control variant in the 90x30 and 90x40 cm schemes, where the ‘Saraton’ variety ranged from 118.2 to 136.4%.

An analysis of the effect of the feeding area on carrot weight showed that when the feeding area was 0.35 m² (70x50 cm), this figure was 2.39 kg or 39.0% compared to the control; at 0.36 m² (90x40 cm) - 2.45 kg or 42.4% higher. In the ‘Saraton’ variety, the weight of cabbage in these variants was 34.6-44.2% higher than the control (Figure 1).

Calculations of the yield of white cabbage grown in the second crop showed that the value of A factor (variety) (EKMT05) for years is 1.1-5.0 tons/ha; the value of B factor (sowing scheme) (EKMT05) varied in the range of 1.7-5.2 tons/ha.

Analysis of the economic feasibility of the sowing scheme used in the cultivation of white cabbage in the secondary crop showed that the cultivation of plants in the planting scheme of 70x30 and 90x30 cm provided 54.4 and 77.7 tons, respectively, in the Sharkiya-2 variety. As productivity increased, the cost of 1 ton of product decreased to 218-165,100 UZS. Profitability was 48.5 and 51.4%, respectively. The yield rate in the variety ‘Saraton’ was in the range of 71.9% in the planting scheme 90x30 cm.

3.2 Determining the optimal planting dates for white cabbage in repeated crops

In this experiment, the results of research on determining the optimal sowing period of white cabbage grown in the crop are presented. Phenological observations showed that the sowing period for repeated cultivation of white cabbage is from June 15 (period 1).

Delay until August 15 (period 2) increased the number of leaves on the plant to 105.3-81.3% in the Sharkiya-2 variety, whereas the ‘Saraton’ variety led to a decrease of 105.5-82.1%. In this regard, the height of cabbage in the Sharkiya-2 variety ranges from 21.1 cm to 17.7 cm; the width of the cabbage was reduced from 25.3 cm to 21.3 cm. The height of cabbage in the 5th sowing period increased by 12.8% compared to the first sowing period in the ‘Saraton’ variety; cabbage width decreased by 27.1%. Outer stem thickness, inner stem thickness, and wet root weight in both varieties were 7.8 from the first sowing period to the fifth sowing period; 49.3 and 15.3 percent, respectively.

Cabbage weight from 2.75 kg in the Sharkiya-2 variety in the first sowing period, and in the fifth period, it decreased to 1.88 kg or 46.3%. In the ‘Saraton’ variety, this figure decreased from 2.85 kg to 2.00 kg, respectively (Figure 2).
The yield indicators of the sowing period were also influenced by the same trend as the size and weight of the cabbage. Consequently, the yield in the Sharkiya-2 variety decreased from the first sowing period (83.8 tons/ha) to the fifth sowing period (48.4 tons/ha) to 73.1%, while in the ‘Saraton’ variety this figure decreased to 56.9%, respectively, and decreased 86 tons/ha during the first planting period, while in the fifth sowing period it was 54.8 tons/ha.

Analysis of the effect of interrelated traits on white cabbage yield showed that the EKMT05 A (variety) factor was 1.7–2.7 tons/ha; B (sowing time) varied in the range of 2.7–4.4 tons/ha. Consequently, sowing time and the amount of ascorbic acid (mg/%) also had a significant effect on the biochemical performance of white cabbage crop. 13.8-11.8 mg/ in the Sharkiya-2 variety from the first sowing period to the fifth sowing period; In the ‘Saraton’ variety, it ranged from 12.4 to 11.6 mg/%. The amount of dry matter ranged from 7.96 to 7.03%, depending on planting time and varieties.

Analysis of the economic feasibility of different sowing periods in the cultivation of white cabbage in the second crop showed that the sowing of plants on 15.06 (first period) gives high yields. In the experimental variant planted during this period, the cost of 1 ton of product in the variety Sharkiya-2 was 160,000 UZS, while in the variety ‘Saraton’ its cost was in the range around 158,000 UZS. The level of profitability of cultivation by varieties was 56.5 and 58.7%, respectively.

3.3 The effect of different amounts of mineral fertilizers on the yield of white cabbage varieties

The results of the study were conducted to determine the optimal fertilization rate, which allows maximizing the biological productivity of white cabbage varieties grown in the second crop. Phenological observations showed that in the absolute control variant without fertilizer, 10-45% of seedlings in the Sharkiya-2 variety received 33-45 days before planting cabbage. It took 41-57 days for 75% of the plants to start harvesting cabbage. It was noted that this process was accelerated when the amount of nitrogen per hectare was increased to 200-300 kg in the field of Sharkiya-2 varieties of cabbage by applying fertilizer P150K100 and N200-300 kg/ha.

Cabbage height was 111.7% in the variant applied to N300P150K100 kg/ha compared to the second control variant (N150P150K100 kg/ha) in the Sharkiya-2 variety; in the ‘Saraton’ variety - 114.8%. In the Sharkiya-2 variety, in the sixth variant (N300P150K100 kg/ha), the width of the cabbage was 113.5% compared to the second control variant (20.0 cm), while in the ‘Saraton’ variety was 116.1% higher.
kg/ha) than in the formed second control variant, and 115.0-116.7% in the ‘Saraton’ variety. The average yield was 20.2-21.4% higher in variants 5-6 with 100-150 kg of excess nitrogen fertilizer per hectare compared to the recommended control variant in Sharkiya-2 variety, and 15.7-16.6% higher in ‘Saraton’ variety (Figure 3).

In the variants with increased nitrogen content (BC + N<sub>200,250,300</sub> kg/ha) in relation to the control (N<sub>150P<sub>150K<sub>100</sub></sub> kg/ha), the amount of dry matter in cabbage in the phase of ripening rose from 11.1 to 17.5 (6.4%) in the Sharkiya-2 variety and by around 12% from 1.5 to 3.8 in the ‘Saraton’ variety.

Analysis of the economic feasibility of fertilizer application in the re-cultivation of white cabbage showed that the increase in the recommended control of plant nutrition (N<sub>150P<sub>150K<sub>100</sub></sub> kg/ha) to the norm of BC + N<sub>200</sub> and BC + N<sub>250</sub> kg/ha in the Sharkiya-2 variety from 6,000 UZS to 185,000-179,300 UZS. In the ‘Saraton’ variety, this value decreased from 208,700 UZS to 170,800-167,500 UZS.

The level of profitability of crop production increased by 35.2-39.5% in variants 4-5 (BC + N<sub>200,250</sub> kg/ha) with increased nitrogen content compared to the second control variant (28.8%) in the Sharkiya-2 variety. In the ‘Saraton’ variety increased from 39.3% to 46.4-49.2%.

3.4 Irrigation procedures and norms of white cabbage planted in the evening

This experiment represents the results of such research on determining the optimal norms and procedures of irrigation, which allows maximizing the biological productivity of white cabbage varieties grown as the second crop within the crop rotation. In the experiment, the irrigation rate was between 500 and 250 m<sup>3</sup> per hectare in the first phase, while in the second phase, it was between 760-190 m<sup>3</sup>. At the same time, the rate of seasonal irrigation rate decreased by 30-60% in the 80-80% irrigation regime and by 44.2% in the 70-90% irrigation regime compared to the 60-60% control option of the irrigation regime. In the irrigation regime of 70-80% and 80-70%, 25.4 and 18.7% less water was used respectively. The analyzes showed that as the soil moisture before the norm of LFMC (NLFMC) irrigation increased, the duration of irrigation within the first phase decreased from 46 to 40 days, with the average daily water evaporation decreasing from 43 m<sup>3</sup> to 31 m<sup>3</sup> per hectare.

Leaf weight on the cabbage plant (1,255 g) varies between 117.5-112.0% when pre-irrigation soil moisture rises to 90-80% compared to the control variant (60%) in the variety ‘Saraton’, whereas the root weight was noted to vary from 21.0-15.3%. On the other hand, leaf weight in the Sharkiya-2 variety is 23.9-97.9% when the rate of irrigation is increased, while the root weight was higher by 26.1–19.3%.

At the recommended irrigation rate (80-80%), the height of the ‘Saratov’ variety was 21.7 cm and the width was 26.3 cm. In the Sharkiya-2 variety, these figures were 23.6 and 28.0 cm respectively. In the control variant, where pre-irrigation NLFMC was 60-60%, the weight of cabbage in the variety ‘Saraton’ was 2.1 kg and 61.9% more than in the case of soil moisture 80-80% (3.4 kg). In the variant with soil moisture 80-80% compared to the control, the weight of Sharkiya-2 variety cabbage increased by 50.0%.

The effect of irrigation rate was particularly high on white cabbage yields. Consequently, the average yield in the variety ‘Saraton’ was noted that in the control variant of 60-60% it was 71.3 tons per hectare, when the soil moisture before irrigation was increased to 90%, this figure increased to 19.1-61.6%, while in the Sharkiya-2 variety - 13.7-47.3% (Table 1).

A separate observation of the effect of factors studied in experiments on the effect of irrigation regime on the yield of white cabbage showed that EKMT<sub>05</sub> was 1.4-2.2 tons per ha for factor A (variety) and 2.4-3.8 tons per ha for factor B (irrigation regime). Analysis of the economic feasibility of irrigation regimens and norms in the cultivation of white cabbage as the secondary crop showed that the highest economic efficiency was provided in the order of irrigation of plants at LFMC 80-80%. Simultaneously, the level of profitability was 82.6% in the variety ‘Saraton’ and 78.8% in the variety Sharkiya-2. This is 29.5-37.1% higher than the control (60-60%) option.
Table 1. Influence of irrigation regime on cabbage weight and yield (2009-2011)

| LFMC, % | Average cabbage weight | Productivity, t/ha | Average t/ha | Regarding the control, % |
|--------|------------------------|-------------------|--------------|-------------------------|
|        | kg relative to control, % | 2009 | 2010 | 2011 |                          |
| 60-60 control | 2.1 | 100.0 | 75.0 | 71.4 | 67.6 | 71.3 | 100.0 |
| 70-70 | 2.5 | 119.0 | 89.3 | 85.0 | 80.5 | 84.9 | 119.1 |
| 70-80 | 2.8 | 133.3 | 100.5 | 95.2 | 90.2 | 95.1 | 133.4 |
| 70-90 | 3.1 | 147.6 | 110.7 | 105.4 | 99.8 | 105.3 | 147.7 |
| 80-80 | 3.4 | 161.9 | 120.5 | 115.6 | 109.5 | 115.2 | 161.6 |
| 80-70 | 2.7 | 128.6 | 96.4 | 91.8 | 86.9 | 91.7 | 128.6 |
| \(\bar{x}\) | 2.8 | 110.7 | 98.7 | 94.1 | 89.1 | 93.9 | 131.7 |

Sharkiya-2 variety

| LFMC, % | Average cabbage weight | Productivity, t/ha | Average t/ha | Regarding the control, % |
|--------|------------------------|-------------------|--------------|-------------------------|
| 60-60 control | 2.2 | 100.0 | 78.5 | 74.8 | 70.8 | 74.7 | 100.0 |
| 70-70 | 2.5 | 113.6 | 89.3 | 85.0 | 80.5 | 84.9 | 113.7 |
| 70-80 | 2.9 | 131.8 | 103.5 | 98.6 | 93.4 | 98.5 | 131.9 |
| 70-90 | 3.1 | 140.9 | 110.7 | 105.4 | 93.0 | 103.0 | 137.9 |
| 80-80 | 3.3 | 150.0 | 118.7 | 112.2 | 99.0 | 110.0 | 147.3 |
| 80-70 | 3.0 | 136.4 | 107.1 | 102.2 | 90.0 | 99.8 | 133.6 |
| \(\bar{x}\) | 2.8 | 113.3 | 101.3 | 96.4 | 87.8 | 95.1 | 127.3 |

\[\text{EKMT}_{\alpha} = \text{variety as } A \text{ factor}\]
\[\text{EKMT}_{\alpha} = \text{irrigation as } B \text{ factor}\]

Accuracy of the experiment, \(S\bar{x}\)

\(1.9\) \(1.6\) \(1.4\)

3.5 Influence of varieties, sowing periods and sowing schemes on the yield of white cabbage

This experiment is a three-factor, and the results on the impact of varieties, planting times, and planting schemes on the yield and quality of white cabbage varieties grown as the second crop were represented. The analyzes showed that there was no effect of sowing time and planting schemes on some morphological parameters (leaf band length) of white cabbage cultivars and hybrids participating in the experiment. Leaf length was 25.8% higher in the 70x50 cm scheme and 36.9% higher in the 90x30 cm scheme when the seedlings were planted on June 15 compared to the June 30 control variant in the Sharkiya-2 variety. Compared to the June 30 control option, when the seedlings were planted on June 15 in the 70x50 cm and 90x30 cm schemes, the leaf width was 32.2–38.5% greater in the Sharkiya-2 variety. In the Geant F1 hybrid, it was 20.8% larger in the 70x50 cm scheme and 11.2% smaller in the 90x30 cm scheme. When seedlings were planted on 15 June compared to the June 30 control option, the number of leaves in the 70x50 cm scheme in the Sharkiya-2 variety increased by 13.3%. In the Geant F1 hybrid, planting according to the 90x30 cm scheme rendered 27.8% larger. In the Sharkiya-2 variety at the time of planting on 15 June, leaf weight was 12.1% higher when using 70x50 cm scheme than at control and 15.9% higher at 90x30 cm scheme. In the Geant F1 hybrid, these figures were 7.7 and 19.5% higher respectively. In the Sharkiya-2 variety, the leaf level (June 30) was 7.6% higher in the 70x50 cm planting scheme and 9.7% higher in the 90x30 cm scheme than in the control variant. In the Geant F1 hybrid, it was noted that the leaf level increased by 22.5% in the planting scheme of only 70x50 cm compared to the control.

Analysis of cabbage figures formed under the influence of the studied factors showed that compared to the control variant (June 30), the height of cabbage was 16.3% in the Sharkiya-2 variety when planted on 15 June. On the other hand, the Geant F1 hybrid variety accounted for up to 13.3%. No significant differences were found in varietal and hybrid, planting times, and planting widths. Cabbagehead index was higher only in the planting scheme of the Sharkiya-2 variety in the 90x30 cm planting scheme.
In the variant of white cabbage seedlings planted in June, the length of the inner kernel of cabbage in the Sharikiya-2 variety increased by 16.4% compared to the control of both planting schemes, while the Geant F1 hybrid was up 9.1%. A similar indicator of core length was also recorded in the kernel index. Consequently, this figure was 112.4% and 122.7% in the Sharikiya-2 variety and 120.9% and 103.4% in the Geant F1 hybrid. Compared to the control planting schemes, when the seedlings were planted on June 15, the weight of cabbage was 113.7% and 110.8% in the Sharikiya-2 variety and 107.3% and 109.4% in the Geant F1 hybrid.

Control experimental study in the Sharikiya-2 variety for the variant planted on June 30, the three-year average yield was 64.5 tons per ha in the 70x50 cm sowing scheme and 68.7 tons per ha in the 90x30 cm scheme. When the seedlings were planted on June 15, the yield was controlled by a 90x30 cm scheme - 13.5 and 10.6% higher, respectively, than when planted on June 30. Control experiment on the Geant F1 hybrid when seedlings were planted on June 15, yields increased by 7.4% and 9.0%, respectively, compared to those planted on June 30 (Table 2).

Analysis of the economic viability of the recommended variety, sowing scheme, and duration of recultivation of white cabbage showed that when planted in the 90x30 cm scheme in the June 30 control variant of Sharikiya-2, a net profit of 5,021,000 UZS per hectare was obtained 15 days earlier, in contrast to such when planted in a 70x50 cm planting scheme on June 15, a large profit of 6,243,000 UZS (24.3%) was received. In the hybrid Geant F1, this figure (7,346,000 UZS) was 11.2% higher.

**Table 2. Influence of sowing period and sowing schemes on yield of white cabbage varieties (2011-2013)**

| Variety   | Sowing time | Planting scheme, cm | Productivity, t/ha | Average | Regarding the control, % |
|-----------|-------------|---------------------|---------------------|---------|--------------------------|
|           |             |                     | 2011    | 2012    | 2013    |                   |
| Sharikiya-2 | June 15     | 70x50               | 77.5    | 75.3    | 66.7    | 73.2    | 113.5        |
|           |             | 90x30               | 79.4    | 77.6    | 71.0    | 76.0    | 110.6        |
|           | June 30 control | 70x50           | 68.3    | 66.4    | 58.8    | 64.5    | 100.0        |
|           |             | 90x30               | 74.6    | 70.1    | 61.4    | 68.7    | 100.0        |
| Geant F1  | June 15     | 70x50               | 84.6    | 81.2    | 74.5    | 80.1    | 107.4        |
|           |             | 90x30               | 77.8    | 78.8    | 71.3    | 76.0    | 109.0        |
|           | June 30 control | 70x50           | 75.4    | 77.9    | 70.6    | 74.6    | 100.0        |
|           |             | 90x30               | 71.3    | 73.4    | 64.4    | 69.7    | 100.0        |
| EKMT<sub>05</sub> | A and B factors | 4.4        | 3.7    | 3.0    |        |         |
| EKMT<sub>05</sub> | C and AC, BC and ABC | 4.4        | 3.7    | 3.0    |        |         |

The cost per ton of product was 18.0% and 13.2% cheaper in high-yield options. The profitability level of cultivation is 51.8-41.3% for the variants of the Sharikiya-2 variety, while the Geant F1 hybrid’s ranged from 58.3 to 41.6%.

3.6 Influence of varieties, irrigation regime and fertilization norms on the yield of white cabbage

Our last experiment is also a three-factor experiment, which represents the results of research aiming to determine the impact of varietal, irrigation regime and fertilization rates on the yield and quality of white cabbage varieties grown as the second crop. Analyzes showed that in the variety ‘Saraton’ when the nitrogen is increased to N<sub>250</sub> kg/ha compared to the recommended fertilization rate of 80-80% in the irrigation regime, the yield of cabbage could be harvestable 4 earlier, following by cabbage ripening - 6 days. In the W61-19 F1 hybrid, setting that the pre-irrigation NLFMC was 80–80%, and when N<sub>250</sub>P<sub>100</sub>K<sub>100</sub> kg/ha was applied, yield maturation was accelerated by 8 days.

Determining the effect of varietal, hybrid, irrigation regime, and fertilization rate on plant morphological characteristics showed that these measures had no effect on leaf length and width in both varieties at the beginning of the growing season. In the ‘Saraton’ variety and the W61-19 F1 hybrid, the leaf length and width were 118.8% and 122.8% respectively in the phase when the cabbage
began to wrap when irrigated at 80-80% regime compared to the 70-70% irrigation regime.

In the variant with N$_{250}$P$_{150}$K$_{100}$ kg/ha fertilizer in 80-80% irrigation mode, the length of the leaf band at the beginning of cabbage harvesting increased by 111.1% in ‘Saraton’ variety and by 112.5% in W61-19 F1 hybrid; at the end of the growth period, this figures were 119.0% and 111.5% higher, respectively. When applied N$_{250}$P$_{150}$K$_{100}$ kg/ha of mineral fertilizer in the 80-80% irrigation regime compared to the 70-70% irrigation regime, the number of leaves on the plant increased by 12.3% in ‘Saraton’ variety and by 16.5% in W61-19 F1 hybrid during the period when cabbage began to be harvested. The effect of these factors on leaf weight and root system in the plant was negligible.

When the nitrogen content is increased to N$_{250}$ kg/ha in comparison with the recommended fertilization rate in the variant with pre-irrigation soil moisture 70-70% to 80-80%, the height and width of the variety ‘Saraton’ was 109.2% and 105.8%, and in the hybrid W61-19 F1, it was 108.9% and 111.6%, respectively.

Regardless of the fertilization rate, the weight of cabbage in the variety ‘Saraton’ increased by 13.0% and 15.9% when irrigated by 80-80% mode compared to the 70-70% irrigation option. An increase of 13.0 and 15.9% was also recorded in the W61-19 F1 hybrid (Table 3).

### Table 3. Influence of irrigation regime and fertilization norms on variety yield (2012-2015)

| Irrigation schedule, % (B factor) | Fertilization rate, kg/ha (factor C) | Productivity, t/ha | Average | Regarding the control, % |
|----------------------------------|-------------------------------------|-------------------|---------|-------------------------|
|                                  |                                     | 2012   | 2013   | 2014   | 2015   | X     |                     |
| **‘Saraton’ variety**            |                                     |        |        |        |        |       |                     |
| 70-70 control                    | N$_{150}$P$_{150}$K$_{100}$          | 80.3   | 60.7   | 64.7   | 56.6   | 65.6   | 100.0  |
|                                  | BC+N$_{250}$                          | 84.5   | 67.4   | 68.8   | 59.4   | 70.0   | 106.7  |
| 80-80                            | N$_{150}$P$_{150}$K$_{100}$          | 95.1   | 69.3   | 71.2   | 61.2   | 74.2   | 113.1  |
|                                  | BC+N$_{250}$                          | 104.8  | 74.5   | 76.3   | 68.9   | 81.1   | 123.6  |
| **W61-19 F1 Hybrid**             |                                     |        |        |        |        |       |                     |
| 70-70 control                    | N$_{150}$P$_{150}$K$_{100}$          | 85.3   | 68.4   | 75.2   | 60.3   | 72.3   | 100.0  |
|                                  | BC+N$_{250}$                          | 89.4   | 77.1   | 80.1   | 69.5   | 79.0   | 109.3  |
| 80-80                            | N$_{150}$P$_{150}$K$_{100}$          | 94.6   | 81.3   | 79.4   | 71.4   | 81.7   | 113.0  |
|                                  | BC+N$_{250}$                          | 110.1  | 88.1   | 86.6   | 81.4   | 91.6   | 126.7  |
| **EKM T$_{05}$ - A and B factors**|                                     | 1.2    | 2.5    | 2.3    | 1.9    |        |        |
| **EKM T$_{05}$ - C and AC, BC and ABC factors**| 1.2  | 2.5 | 2.3 | 1.9 |
| **Accuracy of the experiment, S X %**| 1.2 | 2.3 | 2.9 | 2.7 |

The studied impact of the factors was particularly evident in the productivity indicators. Therefore, it was noted that the yield per hectare in the variety ‘Saraton’ in the 70-70% control irrigation regime and the application of the recommended (N$_{250}$P$_{150}$K$_{100}$ kg/ha) mineral fertilizers ranged from 80.3 to 56.6 tons and averaged 65.6 t/ha. When the irrigation regime was increased to 80-80% (N$_{250}$ kg/ha) and the nitrogen norm was applied, the yield (81.1 t/ha) was 23.6% higher than the control. In the W61-19 F1 hybrid, the yield increased by 113.0% and 126.7% compared to control at both fertilization rates in the 80-80% irrigation regime.

A study of the effect of varietal, irrigation regime, and fertilization rate on the yield of white cabbage grown in re-planting showed that EKM T$_{05}$ for factors A and B was between 1.2-2.5 t, following by EKM T$_{05}$ C and AC, BC and ABC factors - 1.2-2.5 t, and experimental variability C was 1.2-3.3%. Hence, the importance of irrigation regimes in relation to mineral fertilizers in increasing the yield of white cabbage had become stronger.

Analysis of the recommended variety, irrigation regime, and fertilization rate in the second cultivation of white cabbage showed that the yield per hectare at the same fertilization rate in the 80-80% irrigation regime compared to 70-70% irrigation regime increased by 13.1% in the ‘Saraton’ variety, and W61-19 F1 was 26.7% higher and amounted to 18,550,000 and 22,900,000 UZS, respectively. In the experiment on the 80-80% irrigation mode, the net profit was 29.8% and 53.4%
higher than the control in the variety ‘Saraton’ and hybrid W61-19 F1, the cost of 1 ton of product was up to 181,000-155,000 UZS or 16.8% decreased. Moreover, economic profitability was 37.8-51.4% and 45.7-61.6%.

4. Conclusions

1. The use of 70x30 and 90x30 cm sowing schemes in the repeated cultivation of white cabbage caused to harvest the yield of 54.4 and 77.7 tons per hectare, respectively, in the variety Sharkiya-2. As productivity increased, the cost of 1 ton of product decreased to 218,000-165,100 UZS. Net profitability was 48.5 and 51.4%, respectively. The rate of yield in the variety ‘Saraton’ in the most favorable planting scheme (90x30 cm) was 71.9%.

2. Delay in sowing of white cabbage from June 15 to August 15, the weight of cabbage in the Sharkiya-2 variety decreased from 2.75 kg to 1.88 kg or 46.3%, following by in the variety ‘Saraton’ - from 2.85 kg to 2.00 kg, respectively. The yield of these varieties also decreases in the evening sowing to 73.1 and 56.9%, reaching 83.8 and 54.8 t/ha.

3. The use of June 15 sowing period is very effective in the cultivation of white cabbage in the second cultivation. At the same time, the cost of 1 ton of products in the variety Sharkiya-2 is 160,000 UZS, in the variety ‘Saraton’ - 158,000 UZS, the level of profitability is 56.5 and 58.7%, respectively.

4. Control over the application of the norm of BC + N200 and BC + N250 kg/ha, the cost of 1 ton of product in relation to the variant N150P150K100 kg/ha in the Sharkiya-2 was from 201,600 UZS variety to 185,000-179,300 UZS, and in the ‘Saraton’ variety from 208,700 UZS to 170,800-167,500 UZS. The profitability rate is 39.5% in the Sharkiya-2 variety and 49.2% in the ‘Saraton’ variety.

5. Increasing the soil moisture before irrigation to 90-80% control enables that the weight of cabbage in the variety ‘Saraton’ compared to the 70% option reaches 2.1 kg and 3.4 kg when the soil moisture is increased to 80-80%. In the variant with soil moisture of 80-80% in the variety Sharkiya-2, the weight of cabbage increases by 50.0%. The average yield is 19.1-61.6% when the soil moisture before irrigation is increased to 90% in the variety ‘Saraton’, and 13.7-47.3% in the variety Sharkiya-2.

6. In the re-cultivation of white cabbage within NLFMC provides the highest economic efficiency in the order of 80-80% irrigation. Simultaneously, the level of profitability is 82.6% in the variety ‘Saraton’ and 78.8% in the variety Sharkiya-2. This is 29.5-37.1% higher than the control option.

7. In the re-cultivation of Sharkiya-2 variety of white cabbage, when seedlings were planted on June 15 in the scheme of 70x50 cm, the profit was up to 6,243,000 UZS more than in the control option (June 30; 90x30 cm). In the hybrid Geant F1, this figure exceeded 7,346,000 UZS. Profitability was 51.8% in the Sharkiya-2 variety and for the Geant F1 hybrid, it was 58.3%.

8. In the secondary cultivation, the variety ‘Saraton’ was grown at an irrigation rate of 80-80% and increased nitrogen content of N250 kg/ha, the yield was 23.6% higher than the control and reached 81.1 t/ha. In the W61-19 F1 hybrid, the yield was 126.7% relative to the control at 80-80% irrigation regime and the recommended fertilization rate.

9. Cultivation of white cabbage at different fertilization rates showed an advantage of 80-80% irrigation regime over the 70-70% one. At the same time, the yield per hectare in the variety ‘Saraton’ costs 18,550,000 UZS, which is 13.1% higher than the 70-70% irrigation regime. In the hybrid W61-19 F1, the economic income amounted to 22,900,000 UZS. At this irrigation rate, the yield is between 37.8-51.4% and 45.7-61.6%, respectively, in the variety ‘Saraton’ and the hybrid W61-19 F1.

Application of high-yielding Geant F1 and W61-19 F1 hybrids, as well as regionalized varieties Sharkiya-2 and ‘Saraton’ to farms and dehkan farms to achieve high efficiency in the cultivation of white cabbage in repeated crops on grain-free lands can be endorsed when not reduced the NLFMC soil moisture below 80-80% before irrigation in planting seedlings in the sowing scheme of 90x30 cm. Considering this, it is recommended to feed the plants at the expense of N250P150K100 kg/ha.
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