UDC: 633.88:631.53.01

THE EFFECT OF DIFFERENT SOWING DATES AND AGROECOLOGICAL CONDITIONS ON THE YIELD OF CUMIN (CUMINUM CYMINUM L.) VARIETIES

Nizomov R.A., Khurramov B.Kh.
Institute for Advanced Training and Retraining of Agricultural Personnel
Research Institute of Vegetable, Melon Crops and Potato Growing
E-mail: bioritim@mail.ru

Abstract: This article scientifically analyzes the influence of different sowing dates on phenological development, yield, and economic efficiency in two cumin (Cuminum cyminum L.) varieties: Ch-1 and In-1. The research results showed that sowing date directly affected plant growth rate, flowering period, and seed yield. Under the March 25 sowing date, all morphological and biochemical indicators reached their maximum values in both varieties. Yield was 430 kg/ha in Ch-1 and 415 kg/ha in In-1, while essential oil content was recorded at 3.55% and 3.45%, respectively. The analysis revealed a parabolic relationship between sowing date and yield.

Keywords: cumin, sowing date, variety, yield, essential oil, agrotechnology, economic efficiency.

INTRODUCTION

Cumin (Cuminum cyminum L.) is one of the economically valuable cultivated species among aromatic and essential-oil-bearing plants. It is widely used in the food, pharmaceutical, perfume, and cosmetics industries and is in high demand in both local and international markets. The essential oils and fatty substances contained in cumin seeds determine its main value, while their quantity and quality largely depend on agrotechnical factors, particularly sowing date and agroecological conditions.

Sowing date is one of the key factors determining the biological development of a plant. Changes in sowing time cause significant differences in germination, flowering, fruit setting, and seed maturation phases. Under early sowing, germination may be slower due to low temperatures; however, moderate temperature and sufficient moisture during the flowering period are maintained, which contributes to higher yield. Under late sowing, increased temperature and reduced air humidity shorten the vegetation period, accelerate flowering, and ultimately reduce yield.

Recent international studies also confirm this pattern. Soheyli et al. (2010), in experiments conducted under Iranian conditions, reported that early sowing in late March promoted rapid emergence, increased branching, and higher grain yield. According to Shakeri (2015), late sowing shortened the vegetation period and reduced essential oil accumulation. In line with international findings, the second half of March to early April has been assessed as the most favorable sowing period for cumin.

Under the conditions of Uzbekistan, temperature and moisture vary considerably during March and April; therefore, determining an agroecologically suitable sowing date for each variety is very important. Existing data indicate that sowing date directly affects not only cumin yield, but also essential oil content, seed quality, and economic efficiency. Therefore, this study scientifically analyzes the response of the Ch-1 and In-1 varieties to different sowing dates and determines the optimal sowing date based on their phenological development, yield, and economic indicators.

RESEARCH METHODS

The research was conducted in 2022-2023 in the experimental fields of the Tashkent Experimental Station of the Research Institute of Vegetable, Melon Crops and Potato Growing. The experimental site is located on irrigated light sierozem soils, with a humus content of 1.1-1.3%, total nitrogen of 0.11%, phosphorus of 0.18%, potassium of 1.2%, and pH of 7.1-7.4.

The climate is continental, with a moderately warm spring season and a hot, dry summer. Air temperature was 10-13°C in March, 16-20°C in April, and around 25°C in May, while annual precipitation was 330-350 mm.

Two cumin varieties, Ch-1 and In-1, were selected as the research objects. The varieties differ in their physiological characteristics: Ch-1 is an early-maturing variety, while In-1 is considered a medium-maturing variety. The experiment was arranged for four sowing dates: March 15, March 25, April 5, and April 15.

The experimental design was a two-factor scheme, in which factor A represented varieties and factor B represented sowing dates. Each treatment was arranged in three replications. The area of one plot was 10 m2, and the total experimental area was 240 m2.

The experiments were carried out on the basis of the methodological approaches of Dospekhov B.A. (2011), Litvinov S.S. (2011), Rahimi and Sharifi (2019), and El-Ghorab and El-Massry (2017). Economic efficiency calculations were performed in Microsoft Excel 2023, and indicators such as net income per hectare, production cost, and profitability (%) were analyzed.

RESEARCH RESULTS

The table data show that sowing date significantly affects the morphological development of cumin varieties. In both varieties, the highest growth and development indicators were recorded under the March 25 sowing date. At this time, soil temperature was 12-15°C, and the balance between temperature and moisture created the most favorable environment for plant physiology.

In the Ch-1 variety sown on March 25, plant height was 45.3 cm, the number of branches was 11.2, the number of flower stalks was 17.5, and the number of seeds was 438. These indicators were, on average, 18-22% higher than those obtained under early sowing (March 15) and 10-15% higher than those obtained under late sowing (April 15). This result indicates an optimal match between temperature conditions and photosynthetic activity. Under early sowing, germination was delayed due to low temperature, whereas under late sowing heat and moisture deficiency limited branching.

A similar pattern was observed in the In-1 variety. Under the March 25 sowing date, its indicators were as follows: plant height, 49.5 cm; branching, 11.8; flower stalks, 18.2; and number of seeds, 456. These values were 6-8% higher than those of Ch-1, indicating the greater biomass-forming capacity of In-1.

Table 1. Effect of sowing dates on the morphological indicators of cumin varieties (average for 2023-2025)

Sowing date	Plant height, cm	Number of branches, pcs	Number of flower stalks, pcs	Number of seeds, pcs
Ch-1				
March 15 (control)	36.7	8.3	12.6	362
March 25	45.3	11.2	17.5	438
April 5	41.2	9.6	15.3	410
April 15	38.4	8.5	13.4	382
In-1				
March 15	40.5	8.9	13.7	378
March 25	49.5	11.8	18.2	456
April 5	44.8	10.4	16.0	430
April 15	41.3	9.1	14.2	395

As sowing date was delayed, growth parameters decreased in both varieties: under the April 15 sowing date, plant height declined by 8-12%, while the number of flower stalks and seeds decreased by 10-15%. This is explained by the restriction of photosynthesis and generative organ development as a result of increasing heat and rapid moisture loss.

A high correlation was also identified between sowing date and morphological indicators (r = 0.84-0.90). This means that under moderate sowing conditions, plant branching and seed-forming capacity increase simultaneously.

In conclusion, March 25 was found to be the most suitable sowing date for the Ch-1 and In-1 cumin varieties. At this date, soil temperature, day length, and moisture regime are optimal, enabling morphological indicators and yield potential to reach their maximum levels. In early and late sowing dates, temperature stress restricts growth and shortens the overall vegetation period.

Table 2. Effect of sowing dates on the yield and economic indicators of cumin varieties (average for 2023-2025)

Sowing date	Yield, kg/ha	Essential oil, %	1000-seed weight, g	Cost price, thousand UZS/100 kg	Net income, thousand UZS/ha	Profitability, %
Ch-1						
March 15 (control)	400	3.30	2.45	7100	18 750	80.3

March 25	430	3.55	2.50	6370	26 374	96.3
April 5	415	3.40	2.47	6700	23 890	87.5
April 15	380	3.05	2.42	7400	18 040	68.0
In-1						
March 15 (control)	390	3.20	2.44	7200	19 250	76.9
March 25	415	3.45	2.46	6600	24 499	89.5
April 5	405	3.30	2.45	6900	21 820	82.7
April 15	370	3.00	2.41	7500	17 860	64.9

According to the table data, sowing dates had a clear and consistent effect on yield, essential oil content, and economic indicators of cumin varieties. The highest results in both varieties were observed under the March 25 sowing date, when soil temperature and moisture were most suitable for plant physiology.

In the Ch-1 variety sown on March 25, yield was 430 kg/ha, essential oil content was 3.55%, and 1000-seed weight was 2.50 g, representing the highest values. At this time, sufficient soil moisture and moderate temperature enabled active photosynthesis and lipid accumulation. Under early sowing (March 15), low temperature slowed plant growth and reduced yield by 7-8%; under late sowing (April 15), heat stress and moisture deficiency reduced yield by 12%.

A similar trend was observed in the In-1 variety. Under the March 25 sowing date, yield was 415 kg/ha, essential oil content was 3.45%, and seed weight was 2.46 g. Economic indicators were also high: production cost was 6,600 thousand UZS/100 kg, net income was 24,499 thousand UZS/ha, and profitability was 89.5%.

In the early and late sowing treatments, profitability decreased to 76.9% and 64.9%, respectively. This is explained by increased agrotechnical costs and lower yield when sowing is delayed.

According to the analysis, the correlation coefficient between yield and essential oil content was high ($r = 0.87$-0.91), indicating that these traits are physiologically interrelated. In other words, with properly selected agrotechnology, it is possible to achieve both high yield and high oil content.

Overall, among the tested sowing dates, March 25 was the most favorable date for cumin cultivation. At this time, not only biological productivity but also economic efficiency reaches the highest level. Therefore, the precise determination of sowing date in agrotechnical practices is a key factor in improving the efficiency of cumin cultivation.

CONCLUSIONS

1. Sowing date is a decisive factor affecting the growth and development of cumin varieties. According to the experimental results, as sowing date was delayed, phenological stages shortened and plant morphological indicators (height, branching, number of flower stalks, and number of seeds) decreased. The highest values in both varieties were recorded under the March 25 sowing date.

2. The Ch-1 variety stood out as an early-maturing and stable-yielding variety. Although some of its morphological indicators were slightly lower, it is considered agrotechnically efficient due to its early maturity and high yield potential. The highest yield, 430 kg/ha, and essential oil content, 3.55%, were recorded under the March 25 sowing date.

3. The In-1 variety was distinguished by its biomass-forming capacity and active root system. Under the March 25 sowing date, plant height in this variety reached 49.5 cm, the number of seeds reached 456, and yield was 415 kg/ha. Essential oil content was 3.45%.

4. A strong positive correlation (r = 0.87-0.91) was identified between yield and essential oil content. This means that, under correctly selected agrotechnical conditions, both yield and product quality can increase simultaneously. This demonstrates the coordinated course of physiological and biochemical processes in cumin varieties.

5. According to the economic analysis, sowing on March 25 was the most efficient option. At this date, net income amounted to 26,374 thousand UZS/ha in Ch-1 and 24,499 thousand UZS/ha in In-1, while profitability was 96.3% and 89.5%, respectively. Under early and late sowing dates, profitability decreased by 15-25%. Therefore, depending on agroclimatic conditions and varietal characteristics, mid-spring, around March 25, is recommended as the optimal sowing period for cumin.

REFERENCES:

1. Dospekhov, B.A. Methodology of Field Experiments with the Fundamentals of Statistical Processing of Research Results. 5th ed., revised and expanded. Moscow: Agropromizdat, 1985. 351 p.
2. Esfandiari, E., Shekari, F., and Sadeghzadeh, B. Interaction of sowing date and irrigation regime on yield and essential oil of cumin (Cuminum cyminum L.). Iranian Journal of Field Crops Research, 2009, Vol. 7(2), pp. 125-134.
3. FAO. World Production and Climatic Adaptation of Cumin (Cuminum cyminum L.). Rome: Food and Agriculture Organization of the United Nations, 2023. 42 p.
4. Karimov, A. Physiology and Agrotechnology of Essential Oil Plants. Tashkent: Fan Publishing House, 2019. 214 p.
5. Litvinov, A.V. Methods of Agronomic Research. Moscow: KolosS, 2001. 320 p.
6. Mheidi, A., Jafari, M., and Karimi, H. Interaction effect of sowing date and micronutrient application on yield and oil content of cumin (Cuminum cyminum L.). Agricultural Research Communications, 2025, Vol. 42(1), pp. 33-39.
7. Nurmatov, B., Karimov, A., and Khayitov, Sh. Effect of sowing dates on the growth and yield of cumin varieties. Bulletin of Agriculture of Uzbekistan, 2021, No. 3, pp. 47-52.
8. Rawal, R.D., and Patel, J.R. Effect of sowing time on growth, yield and quality of cumin (Cuminum cyminum L.) varieties under Gujarat conditions. Indian Journal of Agronomy, 2014, Vol. 59(2), pp. 170-175.

9. Shakeri, M. Study of phenological traits and essential oil accumulation of cumin at different sowing times. Journal of Medicinal Plants Research, 2015, Vol. 9(4), pp. 102-108.
10. Soheyli, H., Khorasani, R., and Vafaie, A. Influence of planting dates on growth and yield of cumin cultivars under Khorasan climatic conditions. Journal of Agricultural Science, 2010, Vol. 15(3), pp. 211-217.
11. Tabriz Agricultural Research Institute. Effect of Different Sowing Dates (March-April) on Cumin Phenology and Yield under Semi-Arid Conditions. Tabriz, Iran, 2020. 18 p.
12. Ministry of Agriculture of the Republic of Uzbekistan. Methodological Guidelines for Organizing the Sowing, Care, and Harvesting of Agricultural Crops. Tashkent, 2023. 68 p.