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The Influence of Different Planting Dates on the Duration of Plant Phenophases in Cucumber Cultivation Under the Soil and Climatic Conditions of Karakalpakstan

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Citation: Axmetovna, A. G & Tajetovna, Y. G. The Influence of Different Planting Dates on the Duration of Plant Phenophases in Cucumber Cultivation Under the Soil and Climatic Conditions of Karakalpakstan. American Journal Of Biodiversity 2026, 3(5), 47-52

Received: 10th Feb 2026

Revised: 27th Mar 2026

Accepted: 08th Apr 2026

Published: 25th May 2026



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Abstract: This article presents certain phenological indicators of the cultivation results of Saturn F1 and Zena F1 cucumber hybrids at different planting dates under the soil and climatic conditions of the Republic of Karakalpakstan. The studies evaluated seed germination, 10% and 75% flowering periods, the onset of first harvest, and the total duration of the fruiting period of cucumber hybrids. The experimental results demonstrated that planting dates significantly influence the growth, development, and time to harvest of cucumber hybrids. Determining the most optimal planting date provides an opportunity to obtain high cucumber yields under Karakalpakstan conditions, as well as to effectively utilize favorable temperature conditions during the growing season.

Keywords: cucumber, hybrid, planting date, phenological indicators, seed germination, flowering, first harvest, fruiting period

Introduction

Cucumber (*Cucumis sativus* L.) is one of the widely distributed vegetable crops globally and plays a significant role in the human diet. Its yield and product quality largely depend on growing conditions, the biological characteristics of varieties and hybrids, and the correct selection of planting dates. Especially in the Republic of Karakalpakstan, which features a sharply continental climate, spring temperature fluctuations, soil warming levels, and varying atmospheric humidity throughout the season exert a substantial impact on the growth and development of cucumbers.[1]

Since cucumber is a heat-loving crop, ensuring optimal temperature conditions is essential for rapid and uniform seed germination, intensive plant growth, flowering, and the onset of the first harvest. Selecting a planting date that is too early or too late relative to the norm can affect the speed of seed germination, the initiation of the flowering phase, and the overall fruiting period. Therefore, determining planting dates adapted to specific soil and climatic conditions represents one of the crucial elements of cucumber cultivation technology.[2]

In recent years, the use of high-yielding, environmentally adaptable, and early-maturing hybrids in cucumber production has been expanding. However, the response of each hybrid to different planting

dates varies. Thus, studying the phenological development characteristics of promising cucumber hybrids under the specific soil and climatic conditions of Karakalpakstan holds significant practical importance.[3]

Based on this, the primary objective of the research is to determine the effect of different planting dates on seed germination, flowering, the onset of first harvest, and the fruiting period of Saturn F1 and Zena F1 cucumber hybrids under the soil and climatic conditions of the Republic of Karakalpakstan.[4]

Materials and Methods

Field experiments were conducted at the Educational and Scientific Field Farm under the Karakalpakstan Institute of Agriculture and Agrotechnologies during the period of 2024–2026. In the experiments, Saturn F1 and Zena F1 cucumber hybrids were studied under open-field cultivation conditions.[5]

The planting scheme was set with a distance between double-strip rows of 140 cm, a row spacing of 70 cm, and an in-row plant spacing of 40 cm, resulting in a plot feeding area of 8.4 m². Each experimental plot contained 40 plants.[6]

Results

Research results demonstrated that under the sharply continental conditions of the Republic of Karakalpakstan—where air temperatures rise rapidly and relative air humidity decreases during the spring-to-summer transition period—the phenological development of cucumber hybrids is significantly dependent on the planting date. In the experiment, Saturn F₁ and Zena F₁ hybrids were planted in the III decade of April, as well as the I, II, and III decades of May, with the I decade of May serving as the control variant [7], [8].

During the study period of 2024–2026 under Karakalpakstan conditions, a sharp rise in air temperature was observed from April to May. Consequently, while the thermal regime of the soil was relatively lower in variants planted during the III decade of April, the temperature increase in the II–III decades of May created favorable conditions for the rapid and uniform germination of seeds. This pattern was clearly manifested in both hybrids [9].

When the Saturn F₁ hybrid was planted in the III decade of April, it required 9 days for 10% seed germination and 12 days for 75% seed germination, with a seed germination rate of 71.6%. In the control variant—planted in the I decade of May—10% germination was observed in 7 days and 75% germination in 10 days, with the seed germination rate reaching 84.8%.[10]

Thus, planting in the III decade of April delayed seed germination by 2 days compared to the control, and the seed germination rate was 13.2% lower (a relative decrease of 15.6%). This condition can be attributed to the soil and air temperatures at the end of April in Karakalpakstan not being sufficiently stable for rapid cucumber seed germination. In the III decade of April planting, 10% female flowering was observed on the 36th day, and 75% flowering on the 38th day. In the control variant, these indicators were 34 and 36 days, respectively. Thus, early planting delayed the flowering of female flowers by 2 days compared to the control.

Table 1. Phenological indicators of cucumber hybrids at different planting dates under the soil and climatic conditions of Karakalpakstan (2024–2026).

Climate conditions of Kharad, Pakistan (2021-2023).									
Variants		10 %	75 %	Seed germination rate, %	10%	75%	First	Last	Harvestin
		Time required for seed germination, days	Flowering of female flowers		Time until first harvest, days	g period, days			
Saturn F ₁									
III decade of April		9	12	71,6	36	38	44	66	22

Variants	10 %	75 %	Seed germination rate, %	10%	75%	First	Last	Harvestin
	Time required for seed germination, days	Flowering of female flowers		Time until first harvest, days	g period, days			
I decade of May (control)	7	10	84,8	34	36	41	69	28
III decade of May	5	6	95,4	33	34	38	86	48
III decade of May	4	6	94,8	33	34	38	87	49
Zena F ₁								
III decade of April	9	13	72,6	37	37	44	67	23
I decade of May	8	11	85,1	35	36	41	69	28
II decade of May	5	7	96,1	33	33	38	87	49
III decade of May	5	6	94,8	32	33	38	87	49

In the variant planted in the third decade of April, the first harvest began on day 44, which was a delay of 3 days compared to the control. The final picking was completed on day 66, ending 3 days earlier than the control (day 69). As a result, the harvesting period lasted only 22 days, producing yield for 6 days fewer than the control (28 days).[11]

Sowing in the first decade of May significantly accelerated the phenological development of the Saturn F₁ hybrid. 10% seed germination was observed on day 5, and 75% germination occurred on day 6. This was 2 and 4 days earlier than the control, respectively. Seed germination rate reached 95.4%, which was 10.6% higher than the control.[12]

When sown in the second decade of May, 10% flowering of female flowers was recorded on day 33, and 75% flowering on day 34. Compared to the control, this process differed by 1 and 2 days, respectively. The first harvest began on day 38, yielding produce 3 days earlier than the control. Notably, the final harvest period extended sharply, lasting up to day 86, which provided a harvesting period 17 days longer than the control. Consequently, the harvesting period reached 48 days, extending by 20 days or 71.4% compared to the control (28 days).

When sown in the third decade of May, 10% seed germination was observed on day 4, and 75% germination on day 6. Compared to the control, 10% germination accelerated by 3 days, and 75% germination by 4 days. Seed germination rate was 94.8%, which was 10.0% higher than the control.[13] 10% and 75% flowering of female flowers were observed on days 33 and 34, respectively, occurring 1–2 days earlier than the control. The first picking started on day 38, which was 3 days earlier than the control. The last picking continued up to day 87, lasting 18 days longer than the control. The harvesting period lasted 49 days, extending by 21 days or 75.0% compared to the control.

When the Zena F₁ hybrid was planted in the third decade of April, 10% seed germination was observed on day 9 and 75% germination on day 13. Seed germination rate was 72.6%. In the control variant, these indicators were 8 and 11 days, and 85.1%, respectively.

Additionally, when sown in the third decade of April, 10% germination was delayed by 1 day and 75% germination by 2 days compared to the control.

10% flowering of female flowers was observed on day 37, a delay of 2 days compared to the control. 75% flowering was also recorded on day 37, which was 1 day later than the control (day 36).

The first harvest began on day 44, delaying by 3 days relative to the control. The final harvest was picked on day 67, concluding 2 days earlier than the control (day 69). The harvesting period was 23 days, 5 days shorter than the control. When sowing the Zena F₁ hybrid in the second decade of May, 10% seed germination was observed on day 5 and 75% germination on day 7. Compared to the control, this process accelerated by 3 and 4 days, respectively.

Seed germination rate reached 96.1%, which was 11.0% higher than the control (85.1%). This represents the highest seed germination rate recorded among the studied sowing dates for the Zena F₁ hybrid.

10% and 75% flowering of female flowers occurred on day 33, differing by 2 and 3 days, respectively, compared to the control. The first harvest began on day 38, which was 3 days earlier than the control.

The last harvest continued up to day 87, lasting 18 days longer than the control.

In the third decade of May sowing, 10% seed germination was observed on day 5 and 75% germination on day 6. Compared to the control, these periods were reduced by 3 and 5 days, respectively.

Seed germination rate was 94.8%, which was 9.7% higher than the control. However, this result was 1.3% lower than the 96.1% recorded in the second decade of May.

10% flowering of female flowers occurred on day 32, which was 3 days earlier than the control, while 75% flowering occurred on day 33, also 3 days earlier than the control. The first harvest began on day 38, showing a 3-day difference compared to the control.

The last harvest lasted up to day 87, concluding 18 days later than the control. The harvesting period was 49 days, extending by 21 days or 75.0% compared to the control.

While 12 days were required for 75% germination in the Saturn F₁ hybrid in the third decade of April, only 6 days were required in the second and third decades of May. In other words, the germination period was reduced by half.

In the Zena F₁ hybrid, 75% germination took 13 days in the third decade of April, but decreased to 7 days in the second decade of May and to 6 days in the third decade of May.

In the conditions of Karakalpakstan, this can be directly attributed to the rise in soil temperature toward the end of spring. Since cucumber is a thermophilic crop, the increased heat in May creates favorable conditions for accelerating enzymatic and physiological processes in seeds, resulting in rapid and uniform seed germination.[14]

In the Saturn F₁ hybrid, this indicator increased from 71.6% in the third decade of April to 95.4% in the second decade of May, while in the Zena F₁ hybrid it increased from 72.6% to 96.1%.

Directly comparing the third decade of April with the second decade of May, seed germination rate increased by 23.8% in Saturn F₁ and by 23.5% in Zena F₁. This demonstrates that optimizing the sowing date is of great importance for establishing a uniform crop density under field conditions.

With delayed sowing dates, the emergence of female flowers also accelerated relatively. In the Saturn F₁ hybrid, 75% female flowering was observed on day 38 in the third decade of April, but was reduced to day 34 in the second and third decades of May — indicating a 4-day shift toward earlier flowering.

In the Zena F₁ hybrid, this indicator decreased from 37 days in the third decade of April to 33 days in the second and third decades of May, recording a 4-day shift toward earlier flowering.[15]

The first harvest was also strongly dependent on the sowing date. In both hybrids, the first harvest was picked on day 44 in the third decade of April, whereas it began on day 38 in the second and third decades of May. Thus, the biological period of the plants from sowing to the first harvest was shortened by 6 days.

Discussion

The findings demonstrate that planting date is a critical agronomic factor regulating the phenological development of Saturn F₁ and Zena F₁ cucumber hybrids under the sharply continental conditions of Karakalpakstan. The faster and more uniform germination observed in the second and third decades of May can be explained by the progressive increase in soil and air temperatures toward the end of spring, which provides more favorable thermal conditions for the physiological and enzymatic processes involved in cucumber seed germination. As a thermophilic crop, cucumber responds strongly to temperature conditions during establishment; consequently, the relatively cooler and less stable conditions associated with planting in the third decade of April delayed germination, flowering, and the onset of harvesting. The improvement in germination associated with May planting was

subsequently reflected in faster reproductive development, as female flowering and the first harvest occurred earlier in both hybrids. More importantly, later planting substantially extended the harvesting period, indicating that synchronization between crop development and favorable seasonal temperatures can influence not only crop establishment but also the duration of productive growth. This response was consistent across Saturn F₁ and Zena F₁, although Zena F₁ showed a slightly higher germination rate under the second-decade-of-May treatment, suggesting some hybrid-specific variation in adaptation to the prevailing environmental conditions. These findings reinforce the importance of adjusting planting schedules to local soil and climatic conditions rather than applying a fixed calendar-based recommendation. From a practical perspective, planting during the second or third decade of May appears particularly suitable for achieving rapid crop establishment, earlier harvesting, and a longer productive period under Karakalpakstan conditions. Nevertheless, because the present evaluation focused primarily on phenological indicators, further studies integrating marketable yield, fruit quality, soil moisture, temperature dynamics, irrigation requirements, and economic returns would provide a more comprehensive basis for defining the optimal planting date for commercial cucumber production in the region.

Conclusion

In the conditions of Karakalpakstan, the phenological development of Saturn F₁ and Zena F₁ cucumber hybrids was strongly dependent on the sowing date. Sowing in the second decade of May resulted in a seed germination rate of 95.4% for Saturn F₁ and 96.1% for Zena F₁, increasing by 10.6% and 11.0% compared to the control, respectively. The first harvest began 3 days earlier than the control for both hybrids. The harvesting period reached 48 days for Saturn F₁ and 49 days for Zena F₁, extending by 20 and 21 days compared to the control, respectively.

In the third decade of May, the seed germination rate was 94.8% for both hybrids. The first harvest began on day 38, showing a 3-day difference compared to the control. The harvesting period for both hybrids was 49 days, extending by 21 days or 75.0% compared to the control for Saturn F₁, and likewise by 21 days or 75.0% for Zena F₁.

Under the conditions of Karakalpakstan, sowing in the second and third decades of May stood out as the most favorable periods for the Saturn F₁ and Zena F₁ hybrids in terms of phenological parameters. The second decade of May ensured the highest seed germination rate, as well as the maximum duration of the harvesting period. The Zena F₁ hybrid demonstrated a slight superiority over Saturn F₁ in certain indicators, particularly in seed germination rate and early development of female flowers.

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