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Article

The Influence of Different Sowing Dates on The Duration of Phenophase Transition in Plants When Growing Bamiya in The Soil and Climatic Conditions of Karakalpakstan

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Abstract: This article presents a scientific analysis of seed germination, growth and development periods, as well as the pace of phenological phases during the cultivation of Bamiya (Abelmoschus esculentus L.) K-78 and K-95 in various sowing dates (April II, III decades and May I, II decades) in the sharply continental climate of the Republic of Karakalpakstan in 2023-2025. According to the research results, in variants sown in the first and second decades of May, seed field germination reached the highest indicator (91-96%), and the time required for seed germination was reduced to 6-8 days. It was also established that when sown in the first decade of May, the fruiting period reached the maximum level of 74 days for the K-78 sample, 74 days for the K-95 sample, and the final harvesting period increased to 131–132 days. Research results show that in the Aral Sea region, the optimal sowing date for obtaining a high and high-quality harvest of bamia is the first decade of May.

Keywords: Bamia, Variety, Sample, Seeds, Seed Germination, Flowering, First Harvest, Term, Decade, Fruiting Period

Introduction

Ensuring food security on a global scale, regularly providing the population with high-nutritional-value and medicinal vegetable products, and expanding crop diversity in agriculture remain one of the pressing issues. In recent years, extensive research has been conducted on the introduction of non-traditional, drought- and heat-tolerant vegetable crops and their adaptation to local conditions in regions experiencing global climate change, aridity, and water scarcity.[1][2]

One such valuable and promising crop is okra, a lesser-known vegetable, whose fruit contains vitamins (A, C, K, and B-complex), mineral salts (calcium, potassium, magnesium, iron), complex proteins, and, most importantly, dietary fiber (cellulose) and complex polysaccharides that improve gastrointestinal tract function, all of which are highly beneficial to the human body. Furthermore, the okra plant is distinguished by its high tolerance to heat and drought.[3][4]

The Republic of Karakalpakstan, which is considered the northern region of Uzbekistan, is a complex agro-climatic area characterized by a sharply continental climate, soil salinity levels, unstable spring temperatures, aridity during the summer months, and limited water resources. Under these unfavorable ecological conditions, the successful cultivation of okra, ensuring its high yield and product quality, depends primarily on correctly chosen planting dates and the biological characteristics of cultivar specimens.[5]

In vegetable growing, planting date is a key agrotechnical factor that determines the optimal temperature, light, and moisture regimes necessary for seed germination, plant growth, and fruit maturation. When planted too early (during a period when air and soil temperatures have not yet sufficiently warmed), seeds may rot in the soil for an extended time or their field germination rate may drop sharply. When planted too late, the vegetation period of the plant shortens, the fruiting period coincides with autumn frosts, and overall yield decreases.[6]

Materials and Methods

Field experiments were conducted during 2023–2025 at the Educational and Research Field Farm attached to the Karakalpakstan Institute of Agriculture and Agrotechnologies. In these trials, two okra cultivar samples, K-78 and K-95, were studied in open-field conditions at four different planting dates.

The row spacing was 70 cm, the spacing between plants within a row was 40 cm, and the feeding area of the plots was 5.6 m^2. Each plot contained 20 plants.[7][8]

The main objective of this research is to comprehensively study the dynamics of phenological phase progression, field germination of seeds, and the duration of the fruiting period of okra cultivar samples K-78 and K-95 under the soil and climatic conditions of the Republic of Karakalpakstan at different planting dates (second and third decades of April, and first and second decades of May), and to scientifically substantiate the optimal planting date.[8]

Results and Discussion

According to the analysis of phenological indicators of okra cultivar samples in relation to planting dates, it was observed that seed germination, field germination rate, flowering, and fruiting period of the K-78 and K-95 okra cultivars varied significantly depending on the planting date. For both cultivar samples, the planting date in the third decade of April was adopted as the control.[9]

When cultivar sample K-78 was planted in the second decade of April, 10 % of seeds germinated in 15 days, and 75 % in 18 days. In the control variant, these indicators were 10 and 13 days, respectively. Thus, in the early-planted variant, the germination of 10 % and 75 % of seeds was delayed by 5 days compared to the control.[10]

In the variant planted in the second decade of April, field germination rate was 73 %, which was 8 % lower than the control variant (81 %). For cultivar sample K-78, 10 % flowering was observed at 53 days and 75 % flowering at 55 days in the second decade of April planting. This was 1 day later than the control in both cases. The first harvest began 60 days after planting, which was 1 day later compared to the control. The final harvest was collected on day 121, which ended 4 days earlier than the control variant. As a result, the fruiting period lasted 61 days, which was 5 days shorter than the 66 days in the control variant.[11]

When planted in the first decade of May, 10 % of seeds of cultivar sample K-78 germinated in 6 days, and 75 % in 7 days. Compared to the control, germination of 10 % of seeds accelerated by 4 days, and 75 % by 6 days. Field germination rate was 96 %, which was 15 % higher than in the control variant. In the first decade of May planting, 10 % flowering was observed at 50 days and 75 % flowering at 52 days, beginning 2 days earlier than the control. The first harvest was collected 57 days after planting, ripening 2 days earlier compared to the control. The final harvest continued until day 131, ending 6 days later than the control. As a result, the fruiting period lasted 74 days, which was 8 days longer than in the control variant.[12]

Table 1. Phenological indicators of okra cultivar samples when planted at different planting dates (2023–2025).

Variants	Time to germination, days		Field germination rate, %	Flowering		Time to harvest, days		Fruiting period, days
	10 %	75 %		10%	75%	First	Last	
K-78								
Second decade of April	15	18	73	53	55	60	121	61
Third decade of April (control)	10	13	81	52	54	59	125	66
First decade of May	6	7	96	50	52	57	131	74
Second decade of May	6	7	91	50	52	57	130	73
K-95								
Second decade of April	16	18	72	54	56	61	119	58
Third decade of April (control)	10	13	82	53	55	60	124	64
First decade of May	6	8	95	52	53	58	132	74
Second decade of May	6	7	92	52	53	58	131	73

When cultivar sample K-78 was planted in the second decade of May, 10 % and 75 % seed germination were observed in 6 and 7 days, respectively. This was 4 and 6 days earlier compared to the control. Field germination rate was 91 %, which was 10 % higher than in the control variant. At this planting date, 10 % and 75 % flowering were recorded at 50 and 52 days, respectively, accelerating by 2 days compared to the control. The first harvest was collected on day 57, i.e., 2 days earlier than the control. The final harvest was completed on day 130, lasting 5 days longer than the control. The fruiting period lasted 73 days, which was 7 days longer than in the control variant.[13]

Thus, for cultivar sample K-78, planting in the first decade of May provided the most optimal results in terms of field germination rate and fruiting period. At this date, field germination rate reached 96 %, which was 15 % higher than the control, and the fruiting period was extended by 8 days.

When cultivar sample K-95 was planted in the second decade of April, 10 % of seeds germinated in 16 days, and 75 % in 18 days. In the control variant, these indicators were 10 and 13 days, respectively. In the early-planted variant, 10 % germination was delayed by 6 days compared to the control, and 75 % germination by 5 days.[14]

At this planting date, field germination rate was 72 %, which was 10 % lower than the 82 % in the control variant. This indicates that K-95 cultivar seeds are more sensitive to low spring temperatures and soil moisture conditions.

When cultivar sample K-95 was planted in the second decade of April, 10 % flowering was observed at 54 days and 75 % flowering at 56 days. This was 1 day later compared to the control. The first harvest was collected on day 61, which was 1 day later than the control variant. The final harvest was completed on day 119, ending 5 days earlier than the control. As a result, the fruiting period lasted 58 days, which was 6 days shorter than in the control variant.

When cultivar sample K-95 was planted in the first decade of May, 10 % of seeds germinated in 6 days and 75 % in 8 days. Compared to the control, 10 % germination accelerated by 4 days and 75 % germination by 5 days. Field germination rate was 95 %, which was 13 % higher than in the control variant.

When cultivar sample K-95 was planted in the second decade of May, 10 % of seeds germinated in 6 days and 75 % in 7 days. This was 4 and 6 days earlier compared to the control, respectively. Field germination rate was 92 %, which was 10 % higher than in the control variant.

In the second decade of May, 10 % flowering was observed at 52 days and 75 % flowering at 53 days, which began 1 and 2 days earlier compared to the control, respectively. The first harvest was collected on day 58 and ripened 2 days earlier than the control. The final harvest was completed on day 131, lasting 7 days longer than the control. The fruiting period lasted 73 days, which was 9 days longer than in the control variant.

For cultivar sample K-95, planting in the first decade of May also proved to be the most optimal variant in terms of phenological indicators. At this date, field germination rate was 13 % higher than the control, and the fruiting period was extended by 10 days.[15]

Conclusion

The results showed that with delayed planting dates, the seed germination period shortened and field germination rate increased. Under favorable temperature conditions, physiological and biochemical processes in the seeds accelerated, ensuring rapid and uniform germination of seedlings.

At the same time, in the variants planted in the first and second decades of May, flowering and ripening of the first harvest occurred 1–2 days earlier compared to the control, and the fruiting period was extended by 7–10 days.

In the variants planted in the second decade of April, delayed seed germination, reduced field germination rate, and a shorter fruiting period were observed.

For both cultivar samples K-78 and K-95, planting in the first decade of May was determined to be the most optimal phenological timing. This date ensured rapid seed germination, high field germination rate, early onset of flowering and first harvest, and an extended fruiting period.

As a result of planting cultivar sample K-78 in the first decade of May, 10 % and 75 % seed germination occurred in 6 and 7 days, respectively, and field germination rate reached 96 %. Compared to the control, this accelerated seed germination by 4–6 days and increased field germination rate by 15 %. The first harvest began 2 days earlier, and the fruiting period was extended by 8 days.

For cultivar sample K-95, planting in the first decade of May accelerated 10 % and 75 % seed germination by 4–5 days compared to the control. Field germination rate was 95 %, which was 13 % higher than the control. The first harvest was collected 2 days earlier, and the fruiting period was extended by 10 days compared to the control.

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