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Article

Seasonal Development Dynamics of Origanum Majorana L

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Abstract: The increasing demand for medicinal and aromatic plants highlights the importance of developing effective cultivation and propagation strategies. *Origanum majorana* L. is a valuable medicinal and aromatic plant widely used in pharmaceutical and food industries. This study aimed to analyze the seasonal development dynamics of *Origanum majorana* L. under the agro-climatic conditions of Uzbekistan. The research was conducted at the experimental farm of Tashkent State Agrarian University during 2022–2024 using standard phenological observation methods. The results indicated that climatic conditions and sowing time influenced early growth stages, particularly seed germination. Vegetative growth generally occurred from March to mid-June, followed by bud formation and a prolonged flowering period lasting until early November. The total vegetation period ranged from 236 to 240 days in the second and third years. These findings confirm the high adaptability of *Origanum majorana* L. and its suitability for cultivation as a medicinal crop in Uzbekistan.

Keywords: Origanum Majorana L.; Medicinal Plants; Phenological Development; Vegetation Period; Flowering Dynamics; Uzbekistan.

1. Introduction

The steadily increasing global demand for raw materials of medicinal, food, and spice plants necessitates the development of scientifically grounded methods for their introduction, cultivation, propagation, and production under cultivated conditions. Considerable attention worldwide is currently being paid to secondary metabolites of plants used as sources for the perfumery and chemical industries within aromatic and therapeutic programs. One such plant is sweet marjoram (*Origanum majorana* L.), a perennial herbaceous or semi-shrub species native to the Mediterranean region, widely utilized in pharmaceutical and food production.

In recent years, numerous scientific studies and state-level initiatives aimed at the propagation and cultivation of medicinal plants have been implemented in the Republic of Uzbekistan, accompanied by large-scale reforms in this sector. In particular, the implementation of the Resolution of the President of the Republic of Uzbekistan dated November 26, 2020 No. PQ-4901 “On measures to expand the scope of scientific research on the development of cultivation, processing, and seed production of medicinal plants” is envisaged [1].

Within this framework, scientific research on the introduction, propagation, establishment of mother plantations, and cultivation of medicinal plants is being carried out in accordance with the Decree of the President of the Republic of Uzbekistan dated May 20, 2022 No. PF-139 “On measures to create added value chains through efficient use of the raw material base of medicinal plants and support for their processing” [2], as well

as other relevant regulatory and legal documents. The present study contributes, to a certain extent, to the fulfillment of the objectives outlined in these documents.

2. Methodology

Experimental studies were conducted at the educational and research experimental farm of Tashkent State Agrarian University during 2022–2024. The study of seasonal development dynamics of plants was carried out using the methodologies of G.N. Zaitsev [5], I.V. Borisova [4], and I.N. Beideman [3]. During the vegetation period, the following phenological stages were recorded: seedling emergence, formation of true leaves, shoot formation and stem growth, budding, onset of flowering, mass flowering, completion of flowering, fruit formation, seed maturation, and overall duration of the vegetation period.

3. Result

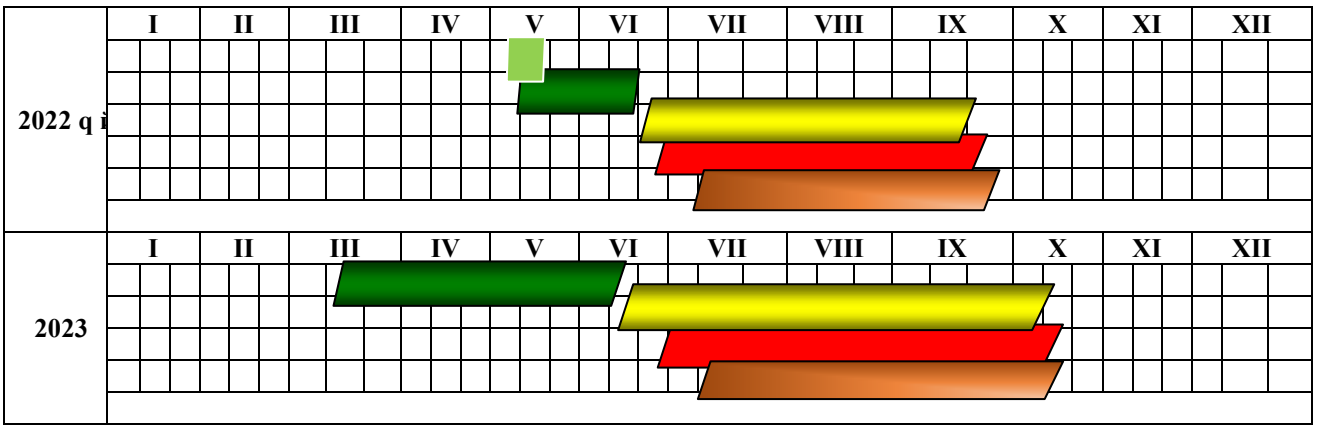
Observations during the first year of vegetation showed that the seasonal development of *Origanum majorana* L. partially depends on sowing dates. In particular, seed emergence was observed 7–10 days after sowing in April, whereas in seeds sown in May this process was shortened to 4–5 days.

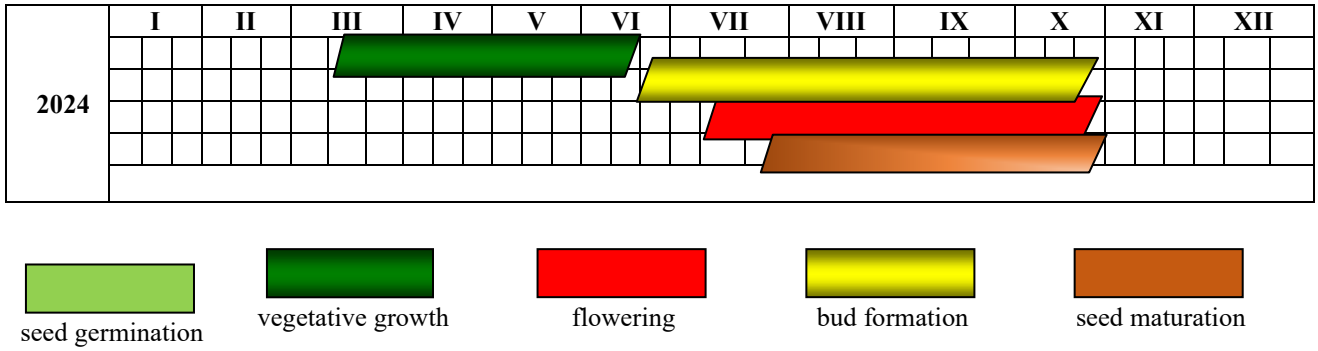
It should be emphasized that during the first vegetation year, plants grown from seeds sown in both periods developed slowly until early May, depending on climatic conditions. Intensive growth was observed from mid-May, while subsequent developmental stages occurred by mid-June regardless of sowing dates.

Specifically, for seeds of *Origanum majorana* L. sown on May 2, 2022, seedling emergence (the onset of vegetation) was observed on May 8. On that day, air temperature and relative humidity were recorded as follows: night +25°C / 41%, morning +24°C / 40%, daytime +31°C / 30%, evening +28°C / 31%. Soil moisture (field moisture capacity) was 70%. Mass emergence occurred on May 11–12, with average air temperature and relative humidity of +25°C / 37% (night +20°C / 46%, morning +20°C / 49%, daytime +31°C / 24%, evening +29°C / 29%), while soil moisture reached 75%. Final emergence was recorded on May 15–19, with air temperatures of +25–29°C, relative humidity of 26.3%, and soil moisture of 75%. The duration of seed emergence for this sowing date was 11 days, whereas for April sowing it ranged from 15 to 18 days.

The vegetative growth stage began on May 12, when cotyledon leaves fully unfolded and increased in size. Intensive growth continued until June 18, lasting a total of 38 days. From June 18 to June 23, vegetative growth temporarily ceased, and plants entered a virginal stage, preparing for transition to the generative phase. From June 23 (47 days after emergence), the first buds began to form. Initial flowering was observed on June 28 and continued until October 6, lasting 71 days. Seed formation began on July 7–11. Seed maturation started on August 17 and continued for a total of 63 days, until early October. Overall, in 2022, the vegetation period of the plants lasted 123–125 days.

(Appendix, **Figure 3.1.** phenospectrum).





Analysis of seasonal development stages showed that in 2023 vegetative growth was slow from March 10 to April 15 and intensive from April 15 to June 10, lasting a total of 93 days. From June 11, plants entered the generative phase, with bud formation occurring between June 11 and 21. Flowering began on June 22 and continued until the third decade of October (October 26), with a total duration of 127–130 days. Fourteen days after the onset of flowering (July 6), seed formation began, with mass seed set observed in the second and third decades of July and the first decade of August. Seed maturation began on July 6, with the first mature seeds recorded on August 19, and continued until late October, lasting a total of 118 days. Overall, the vegetation period in 2023 lasted 236 days (Appendix, Fig. 3.1).

In the third year of life (2024), the onset of vegetation was observed from the second decade of March, depending on climatic conditions. Vegetative growth lasted from March 12 to June 15, extending up to 96 days. Transition to the generative phase was recorded on June 16–18, with buds fully formed by June 20–23. Flowering was observed from July 5–8 and continued until the first decade of November (November 6). In 2024, the total flowering duration was 125 days. Fruit and seed formation began 10–15 days after the onset of flowering (from July 20). The first mature seeds were recorded on September 4 (after 46 days), and maturation continued until early November, lasting a total of 110 days. Overall, the vegetation period (from March 12 to November 6) lasted 240 days.

Mass flowering period of Origanum majorana L.

4. Conclusion

Thus, the seasonal development of Origanum majorana L. is directly influenced by climatic conditions and begins in late March. Vegetative growth lasts from March 12 to

June 15, extending up to 96 days. The budding stage begins on June 16–18, with full bud formation occurring by June 20–25. Flowering lasts from July 5–8 until the first decade of November (November 6). Fruit and seed formation begins 10–15 days later and continues until early November. The overall vegetation period of the plants (from March 12 to November 6) ranges from 236 to 240 days.

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