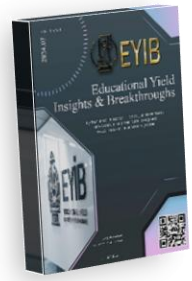
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STUDY OF THE BIOECOLOGICAL, MORPHOMETRIC AND PHYTOCHEMICAL CHARACTERISTICS OF OREGANO (ORIGANUM L.) SPECIES

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Annotatsiya

This article presents the results of the introduction of five species of the genus Origanum L. and of the study of their bioecological, morphometric and phytochemical characteristics. The research was conducted at the experimental farm of Tashkent State Agrarian University. The results show that O. tyttanthum Gontsch. is highly adapted to the sharply continental climate of Uzbekistan and is the most promising species as a strategic, import-substituting raw material. In addition, the seeds of all the studied species were found to be microspermous, and effective agronomic practices for their cultivation, such as sowing the seeds mixed with sand, were substantiated. The data obtained are of considerable importance for establishing commercial oregano plantations and for supplying the pharmaceutical industry with high-quality domestic raw materials.

Kalit so'zlar: Origanum L., introduction, bioecology, phytochemical analysis, microspermous seeds, agricultural technology, pharmaceuticals, raw material base.

Introduction. The flora of Uzbekistan comprises about 4,400 species of higher plants, more than 750 of which possess medicinal properties. At present, about 350 of these medicinal plant species are actively used in official medicine and in the pharmaceutical, food and cosmetic industries. The fact that nearly 40% of modern medicines are derived from plant raw materials demonstrates their strategic importance for the healthcare system.

In recent years, in response to the growing global demand for medicinal plants and within the framework of implementing Decree No. PF-139 and Resolution No. PQ-251 (2022) of the President of the Republic of Uzbekistan, particular attention has been paid to the development of this sector. These regulatory documents are aimed at ensuring the sustainable development of the pharmaceutical industry through the establishment of cultivated plantations of medicinal plants, the expansion of the raw material base, and the creation of value-added chains [1], [2], [3].

Literature review. Global demand for medicines prepared from natural medicinal plants is growing by 6–7% annually. According to international experts, the global turnover of this sector increased from USD 35 billion in 2020 to more than USD 55 billion in 2023 [3], [4]. The genus *Origanum* L. (oregano) has firmly secured a place among the "TOP-10" spice and medicinal plants with the greatest potential in this market [5].

Countries such as Turkey, Greece and Albania are the leading exporters of oregano raw material, with annual export volumes amounting to thousands of tonnes [4]. In particular, Turkey's annual revenue from oregano and its derivatives reaches hundreds of millions of US dollars, accounting for a significant share of the national economy [4]. Germany and France, as major buyers on the spice market, import raw material mainly from Mediterranean countries. A steady increase in demand for oregano essential oil and dried leaves is also observed in the USA [4], [5].

Systematic work is being carried out in the Republic on the introduction of *Origanum* species and their acclimatization to local soil and climatic conditions. Studies conducted at experimental sites in Tashkent and the Fergana Valley confirm that the cultivation of oregano on plantations is of strategic importance for supplying the pharmaceutical sector with high-quality domestic raw materials. The acclimatization of oregano and its cultivation on the basis of modern agricultural technologies, by strengthening the pharmaceutical raw material base, contribute to enhancing the export potential of Uzbek science and industry.

Object and methods of the study. Representatives of the genus *Origanum* L. (oregano), one of the perennial essential-oil plants of the family Lamiaceae Lindl., were selected as the object of the study. Owing to its high value in the medical, perfumery and food industries, this plant is important not only as a natural resource but also as a promising species for introduction into agriculture. The study of the bioecological, morphological and phytochemical characteristics of *Origanum* species provides the basis for developing a technology for their efficient cultivation on commercial plantations.

The research was conducted at the experimental farm of Tashkent State Agrarian University. Five species of *Origanum* L. were selected as the objects of the study. The morphological and biometric parameters of the plants were determined using the methods of T.A. Rabotnov and I.G. Serebryakov. The morphometric parameters of the seeds (length, width, and 1000-seed weight) were analysed for statistical significance ($P<0.05$).

Results and discussion. During the study, the physiological and morphological characteristics of the seeds of *Origanum* L. species obtained from the collection of the Department of Medicinal Plants of Tashkent State Agrarian University were analysed. The 1000-seed weight averaged 0.08–0.12 g; the very small size of the seeds (0.5–0.8 mm) and their surface structure reflect their anemochory (wind dispersal) and their degree of tolerance to environmental stress factors (drought and high temperature). The biometric parameters obtained make it possible to predict the developmental rates of oregano during the growing season and to optimize agronomic conditions, in particular the soil moisture and temperature regime. Furthermore, the close relationship between morphological traits and the biosynthesis of essential oil in the plant highlights the importance of seed selection when establishing commercial plantations.

The commercially important species of the genus *Origanum* L. can be comparatively characterized as follows:

– *O. vulgare* L. (common oregano). Widely distributed across Eurasia; owing to its thymol and carvacrol content, it is used in pharmaceuticals as an antiseptic and antitussive agent;

– *O. onites* L. (Turkish oregano). Distinguished by a high concentration of carvacrol; it is in demand mainly in the food industry (as a spice) and in essential oil production;

– *O. majorana* L. (sweet marjoram). Distinguished by its sabinene and terpineol compounds; it is highly valued in perfumery and cooking;

– *O. tyttanthum* Gontsch. (small-flowered oregano). A Central Asian endemic; owing to its high adaptability to a sharply continental climate, it is of strategic importance for the development of import-substituting medicines;

– *O. dictamnus* L. (Cretan dittany). Ornamental owing to its white-pubescent leaves; it is well known in folk medicine as a wound-healing and anti-inflammatory remedy.

A comparative analysis of these species establishes the scientific and practical foundations for the commercial-scale cultivation of the genus *Origanum* L. under local climatic conditions.

Table 1

Comparative bio-morphometric and chemical characteristics of *Origanum* L. species

Species	Distribution range	Seed size (length/width, mm)	1000-seed weight (g)	Main active compounds	Fields of use in the national economy
O. vulgare	Eurasia	0.6–0.8 / 0.3–0.4	0.08–0.11	Thymol, carvacrol	Pharmaceuticals (antiseptic)
O. onites	Mediterranean	0.5–0.7 / 0.3–0.35	0.07–0.09	Carvacrol (dominant)	Food industry (spices)
O. majorana	North Africa / Asia	0.5–0.6 / 0.2–0.3	0.06–0.08	Sabinene, terpineol	Perfumery, cooking
O. tyttanthum	Central Asia	0.5–0.7 / 0.3–0.4	0.08–0.10	Thymol, p-cymene	Medicines (domestic)
O. dictamnus	Crete, Greece (endemic)	0.6–0.8 / 0.3–0.4	0.09–0.12	Carvacrol, flavonoids	Folk medicine

As can be seen from the table above, *O. tyttanthum* (small-flowered oregano) exhibits the highest capacity for adaptation to the sharply continental climate of Uzbekistan. Moreover, all the species presented have microspermous (very small) seeds, with a 1000-seed weight of about 0.1 g. This feature requires a uniform agronomic approach for all species, namely sowing the seeds mixed with sand.

For pharmaceutical purposes, *O. vulgare* and *O. tyttanthum* have the highest potential (owing to their thymol/carvacrol balance), whereas for the food industry *O. onites* (owing to its high carvacrol concentration) is one of the most promising species.

Conclusions. The research carried out confirmed that the introduction and commercial-scale cultivation of species of the genus *Origanum* L. under the climatic conditions of Uzbekistan are scientifically substantiated and economically highly efficient. The main conclusions of the study are as follows:

1. *Origanum tyttanthum* Gontsch. (small-flowered oregano) is distinguished by its high adaptability and biological stability under the sharply continental climatic conditions of Uzbekistan. This species is the most promising strategic raw material base for the development of import-substituting medicines in the domestic pharmaceutical industry.

2. The seeds of all the studied species were found to be microspermous (very small, with an average 1000-seed weight of 0.1 g). This necessitates a uniform, highly efficient agronomic approach to their cultivation on plantations, namely the technology of sowing seeds mixed with sand.

3. The phytochemical analysis of *Origanum* species identified the target fields of their use:

– *O. vulgare* L. and *O. tyttanthum* Gontsch., owing to their balanced thymol and carvacrol content, are suitable for the production of medicines in the pharmaceutical sector;

– *O. onites* L., owing to its high carvacrol concentration, is the most suitable raw material for the food industry (spices) and for essential oil production.

4. The establishment of oregano plantations directly contributes to creating a sound national base of pharmaceutical raw materials, to the efficient use of agricultural land resources, and to increasing export potential.

Overall, the commercial-scale cultivation of *Origanum* L. species is of great importance for supplying the domestic pharmaceutical sector with high-quality local raw materials and for building a high value-added chain in this field.

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