ECOLOGICAL APPROPRIATION AND INTRODUCTION OF PLANTS OF THE FAMILY LAMIACEAE IN THE CONDITIONS OF UZBEKISTAN

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Abstract: *the introduction of plant species into regions with extreme environmental conditions, such as Uzbekistan, plays a critical role in enhancing ecological diversity and resilience. This study investigates the ecological plasticity and adaptability of Lamiaceae species under Uzbekistan's specific environmental conditions, focusing on traits that influence their successful establishment and adaptation. Through examining key adaptive traits like growth stages and environmental compatibility, the research aims to inform optimal strategies for plant introduction in Central Asia. Results indicate that species with greater ecological plasticity, such as Nepeta and Origanum, exhibit better adaptation to new environments compared to species with narrower ecological requirements. This finding underscores the importance of aligning species selection with regional climate and soil conditions to ensure survival and growth. Additionally, introduced species contribute positively to local biodiversity and offer economic potential, especially medicinal and aromatic plants with traditional and commercial uses. This research supports the expansion of Uzbekistan's flora inventory and promotes sustainable introduction practices to enhance ecological and economic stability in the region.*
Keywords: *Lamiaceae, plant introduction, adaptation, ecological plasticity.*

ЭКОЛОГИЧЕСКАЯ АДАПТАЦИЯ И ВВЕДЕНИЕ РАСТЕНИЙ СЕМЕЙСТВА LAMIACEAE В УСЛОВИЯХ УЗБЕКИСТАНА

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Аннотация: *интродукция растительных видов в регионы с экстремальными экологическими условиями, такие как Узбекистан, играет важную роль в улучшении экологического разнообразия и устойчивости. Данное исследование посвящено изучению экологической пластичности и адаптируемости видов семейства Lamiaceae в условиях Узбекистана, с фокусом на признаках, влияющих на успешное их освоение и адаптацию. Путем анализа ключевых адаптивных признаков, таких как фазы роста и совместимость с окружающей средой, исследование направлено на выработку оптимальных стратегий интродукции растений в Центральной Азии. Результаты показывают, что виды с более широкой экологической пластичностью, такие как Nepeta и Origanum, демонстрируют лучшую адаптацию к новым условиям по сравнению с видами с более узкими экологическими требованиями. Это открытие подчеркивает важность выбора видов, соответствующих региональному климату и почвенным условиям, для обеспечения их выживания и роста. Кроме того, интродуцированные виды способствуют увеличению местного биоразнообразия и имеют экономический потенциал, особенно лекарственные и ароматические растения с традиционным и коммерческим применением. Это исследование поддерживает расширение флоры Узбекистана и способствует устойчивым практикам интродукции для улучшения экологической и экономической стабильности в регионе.*
Ключевые слова: *Lamiaceae, интродукция растений, адаптация, экологическая пластичность.*

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Introduction

The introduction of plants, particularly in regions with extreme environmental conditions, is crucial for developing methods for plant adaptation and successful integration into new ecosystems. As emphasized in P.A. Baranov's works, adapting plants to new natural conditions requires a detailed examination of environmental factors, including temperature and humidity, which play key roles in the territorial establishment of plants [1]. A successful introduction can greatly improve the ecological situation and strengthen regional biodiversity, particularly in Central Asia, which is characterized by a unique but vulnerable biocenosis [10]. Ecological adaptation, which entails plant compatibility with environmental conditions, is essential for successful introduction. Plants that have developed in specific habitats form stable associations with their environment,

which can be observed through their ecological conservatism. For instance, plants adapted to moist soils, saline flats, sands, or gypsum-based soils may experience critical challenges if environmental conditions change [4].

Research Objective

The objective of this study is to investigate the degree of ecological plasticity and adaptability of Lamiaceae species when introduced to Uzbekistan's conditions. The study seeks to identify adaptive traits critical to planning introduction programs. I.V. Belolipov's work [2, 3] serves as a unique study on the phenological and bioecological characteristics of Labiatae (mint family) plants in Tashkent, pinpointing key growth stages like germination, flowering, and fruiting, which vary significantly based on environmental factors. His findings contribute to creating optimal acclimatization strategies for wild Central Asian plants, advancing practical methods for their introduction [2, 3].

Results and Discussion

Studies by K.Z. Zakirov and P.Z. Zakirov [5] also explore the effects of plant introduction on Central Asian biocenoses and ecosystems, revealing that some species positively impact biodiversity and improve ecosystem resilience to climate change. However, as noted by Voroshilov, the developmental rhythm of plants can be unpredictable, necessitating monitoring and management during early acclimatization stages [4]. Over half a century of research on plant introduction and adaptation has significantly contributed to the systematic and eco-biological study of the Lamiaceae family by researchers such as V.N. Kamelin [9], A.M. Makhmedov [12], A.T. Tadjibaev [13] and M.M. Tsukervannik [14]. In Uzbekistan, particular attention has been given to introducing medicinal and essential oil plants, including species of *Mentha* (mint) and *Salvia* (sage). However, systematic analysis of Lamiaceae species' association with soil types remains limited. Experimental studies conducted at the Botanical Garden of Uzbekistan's Academy of Sciences observed introduced plants in typical ancient-irrigated serozem soils, assessing behavior across different conditions (vegetative periods, winter conditions, and drought impacts). The studies focused on plant responses to watering, temperature, light, and interactions with competing weeds.

The typological approach of K.Z. Zakirov and P.Z. Zakirov [5] offers a comprehensive understanding of the roles introduced plant species play in Central Asia's ecosystems. Their ecological contributions, particularly in terms of biodiversity support and erosion control, underscore the potential of these species to enhance ecological stability, even in regions under environmental stress. Further studies based on Zakirov's [5] work can help refine strategies for managing introduced species to maximize their ecological benefits while minimizing any adverse effects on native biodiversity. Kashkarov and Korovin's study from 1931 [10] is foundational in understanding how plant species spread across different ecological pathways. Their research identifies the mechanisms through which introduced flora interacts with native biomes, thereby reshaping the local biodiversity. They explore how these species integrate into established ecosystems, often filling ecological niches left open by native plants. This work remains relevant, especially given the current impacts of climate change on habitat stability and plant distribution. Their research also serves as a basis for discussions on how new species influence biocenoses (biotic communities) by altering food webs, soil chemistry, and water cycles. Climate shifts can exacerbate these impacts, as introduced species may adapt more readily to changing conditions, potentially outcompeting native flora. This can lead to both positive and negative outcomes: some introduced plants help stabilize soils or provide additional resources for local fauna, while others may disrupt existing ecological relationships. Research on the rational use of essential oil plants, as seen in the works of S. Kudryashov and P. Ozolin [11], highlights the economic potential of these species, especially in Central Asia. These studies focus on how the cultivation of oil-bearing plants, such as lavender, mint, and rose, can contribute to local industries by providing raw materials for the production of essential oils, fragrances, and pharmaceuticals. The economic benefits from such plants can be significant; they support local livelihoods, foster agricultural industries, and attract investments in processing facilities for essential oils. This industrial growth, in turn, creates job opportunities, supports social development, and promotes rural economic stability in regions that cultivate these plants. By maximizing the efficiency and output of essential oil-bearing plants, local economies may develop stronger foundations, promoting socio-economic progress across Central Asian communities.

Furthermore, these plants offer potential for export, giving Central Asia a unique position in global markets. Increased production of high-value essential oils contributes not only to local economic stability but also to cultural heritage, as the cultivation of medicinal and aromatic plants has deep historical roots in this region. As such, fostering the economic potential of these plants aligns with both local traditions and modern demands for sustainable development.

M.I. Ikromov's [6, 7, 8] on *Lagochilus* Bunge (commonly known as hare's ear or zaytsegub) have significant implications for both ecological studies and practical applications. *Lagochilus Bunge*, native to Central Asia, has notable importance in traditional and regional uses, especially within the folk medicinal practices of Uzbekistan, Kazakhstan, and surrounding areas. This genus is valued for its pharmacological properties, as it has been traditionally used to treat a range of health conditions, including cardiovascular and blood disorders. The plant's application in folk medicine underscores its active compounds, such as flavonoids, tannins, and essential oils, which have documented effects on blood coagulation and wound healing. M.I. Ikromov's research emphasizes

the plant's practical significance, especially highlighting how its extract has been incorporated in medical treatments related to hemostasis (the process of blood clotting) and wound healing. In traditional contexts, extracts from *Lagochilus* have been used to prepare topical solutions, oils, and ointments for wound care and as an anti-inflammatory agent. Expanding on this foundation, M.I. Ikromov has suggested broader potential applications in pharmacology, particularly as an herbal medicine to complement modern medical practices in hematology and surgery. Furthermore, M.I. Ikromov's [6, 7, 8] studies highlight the plant's adaptability and potential for cultivation, which could be crucial for sustaining its availability as a resource for pharmaceutical industries. Given the plant's medicinal properties, incorporating *Lagochilus* Bunge in broader agricultural or pharmacological industries in Central Asia could support both healthcare and economic initiatives, contributing to the national economy. Further research into its active compounds could lead to the development of standardized drugs, increasing its value for both local and international markets.

V.N. Voroshilov's [4] research on plant development rhythms underscores the importance of predictable growth cycles in successful acclimatization efforts. When introducing non-native species, alignment with local environmental rhythms - such as temperature cycles, precipitation patterns, and soil conditions - is essential. Voroshilov's work highlights that acclimatized plants often face challenges in adapting to new climates, which can affect their growth and reproductive cycles. The adaptation of plants to new environments requires an understanding of these natural rhythms, as well as strategies to overcome barriers like seasonal mismatches, soil composition differences, and pest resistance.

By considering these challenges and employing scientific approaches to support plant adaptation, ecological integration becomes more achievable. Voroshilov's insights into growth rhythms can be particularly valuable when selecting plant species for introduction, guiding researchers to choose species with a higher probability of acclimatization success and ultimately enhancing the resilience of introduced plants within Central Asian ecosystems. Plants with narrow ecological amplitudes-those highly specialized to specific habitatstend - to face greater challenges when adapting to new environments, particularly with changes in soil types. According to I.V. Belolipov [2, 3], studies on translocation between different soil edaphotypes demonstrate that species with broader ecological amplitudes, such as *Nepeta* and *Origanum*, exhibit greater adaptability and resilience in new conditions. In contrast, plants strictly tied to specific ecological niches require careful management and adaptation measures when introduced to new ecosystems. In Uzbekistan, irrigation plays a significant role due to the region's dry climate. *Lamiaceae* species needing intensive watering require additional care during arid periods, which helps mitigate water stress effects. However, certain species within the genus *Eremostachys* display resilience to water scarcity, making them more suitable for dry conditions with minimal irrigation. Experiments in the Botanical Garden of Uzbekistan indicate that winter temperatures and soil freeze conditions significantly affect the survival rates of introduced plants. Cold tolerance appears strongest among species native to climates with similar seasonal patterns, highlighting the importance of matching the climatic origin of introduced species with local conditions for optimal adaptation and survival.

Conclusion

The results of this study highlight the importance of ecological plasticity for the successful acclimatization of plants in Uzbekistan's environmental conditions. Analysis of the adaptive characteristics of *Lamiaceae* species shows that those with a broad ecological range, such as *Nepeta* and *Origanum*, demonstrate higher resilience to changing environmental conditions, which supports their successful establishment. Conversely, species that are narrowly adapted to specific ecological niches require additional adaptation measures when introduced to new environments. The introduction of such plants not only enriches regional biodiversity but also offers significant economic potential, especially for medicinal and aromatic plants valued in traditional and industrial medicine.

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