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Technology for cultivating Oriental arborvitae (*Platycladus orientalis* L.) seedlings under the conditions of the southern districts of the Republic of Karakalpakstan

Qoraqalpog'iston Respublikasi janubiy tumanlari sharoitida Sharq biotasi (*Platycladus orientalis* L.) ko'chatlarini yetishtirish texnologiyasi**Технология выращивания сеянцев туи восточной (*Platycladus orientalis* L.) в условиях южных районов Республики Каракалпакстан****Surayyo QURBANIYAZOVA^{1,*}**¹ Karakalpak Institute of Agriculture and Agrotechnologies, Nukus, Republic of Karakalpakstan, Uzbekistan* Corresponding author: qurbaniyazovasurayyo@gmail.com**ARTICLE INFO****ARTICLE TYPE**

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AUTHOR, TITLE AND ABSTRACT METADATA (EN / UZ / RU)**ENGLISH****Surayyo QURBANIYAZOVA^{1,*}**¹ Karakalpak Institute of Agriculture and Agrotechnologies, Nukus, Republic of Karakalpakstan, Uzbekistan

Abstract. This study investigates the technology of cultivating *Platycladus orientalis* L. seedlings under the soil and climatic conditions of the southern districts of the Republic of Karakalpakstan. Experimental studies conducted in 2025–2026 examined seed propagation, transplantation of one-year-old seedlings, and green cutting propagation using different substrates. The results demonstrated that seedling growth and propagation efficiency depend on the cultivation method and substrate type. Peat produced favorable results in seed propagation, while peat and sandy-loam soil supported the successful establishment of transplanted seedlings. Green cutting propagation showed relatively lower efficiency. The findings confirm the potential of *P. orientalis* for nursery production, afforestation, and ecological restoration in southern Karakalpakstan.

Keywords: *Platycladus orientalis* L.; Oriental arborvitae; seedling cultivation; propagation; substrate; Karakalpakstan; afforestation; ecological restoration

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Annotatsiya. Mazkur tadqiqotda Janubiy Qoraqalpog'istonning tuproq-iqlim sharoitida Sharq biotasi (*Platycladus orientalis* L.) ko'chatlarini yetishtirish texnologiyasi o'rganilgan. Tadqiqotda urug'dan ko'paytirish, bir yillik ko'chatlarni ko'chirib o'tqazish va yashil qalamchalar orqali ko'paytirish usullari turli substratlarda sinovdan o'tkazildi. Natijalar ko'chatlarning o'sishi va ko'paytirish samaradorligi yetishtirish usuli hamda substrat turiga bog'liqligini ko'rsatdi. Torf urug'dan ko'paytirishda, torf va qumloq tuproq esa ko'chatlarni ko'chirib o'tqazishda yaxshi natija berdi. Olingan natijalar *P. orientalis* turidan ko'chatchilik, o'rmon barpo etish va ekologik tiklash ishlarida foydalanish istiqbollarini tasdiqlaydi.

Kalit so'zlar: *Platycladus orientalis* L.; Sharq biotasi; ko'chat yetishtirish; ko'paytirish; substrat; Qoraqalpog'iston; o'rmon barpo etish; ekologik tiklash

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Каракалпакстан, Узбекистан

Аннотация. В статье исследована технология выращивания *Platycladus orientalis* L. в почвенно-климатических условиях южных районов Республики Каракалпакстан. Изучены семенное размножение, пересадка однолетних сеянцев и размножение зелеными черенками с использованием различных субстратов. Установлено, что эффективность размножения и рост растений зависят от способа выращивания и типа субстрата. Наиболее благоприятные результаты при семенном размножении получены при использовании торфа, а при пересадке сеянцев — торфа и супесчаной почвы. Результаты подтверждают перспективность использования *P. orientalis* в питомниковом хозяйстве, лесоразведении и экологическом восстановлении региона.

Ключевые слова: *Platycladus orientalis* L.; туя восточная; выращивание сеянцев; размножение; субстрат; Каракалпакстан; лесоразведение; экологическое восстановление

1. INTRODUCTION

Climate change, land degradation, water scarcity, and desertification have increased the importance of developing effective afforestation and ecological restoration technologies for arid regions. This issue is particularly relevant to the Republic of Karakalpakstan, where the environmental consequences of the Aral Sea crisis, high temperatures, limited precipitation, dry winds, and unfavorable soil conditions create significant challenges for the cultivation of woody plants.

The successful implementation of afforestation programs depends largely on the selection of environmentally adaptable tree species and the production of high-quality planting material. *Platycladus orientalis* L., commonly known as Oriental arborvitae, is a promising evergreen species characterized by its adaptability to drought, temperature fluctuations, and relatively adverse environmental conditions. However, the technology for cultivating its seedlings under the specific soil and climatic conditions of southern Karakalpakstan remains insufficiently studied.

The effectiveness of seedling production depends primarily on the propagation method and the physical and chemical properties of the growing substrate. Seed propagation, transplantation of young seedlings, and vegetative propagation through green cuttings differ in their biological efficiency and technological requirements. Similarly, substrates such as peat, humus, sandy-loam soil, and organic soil mixtures can significantly influence seed germination, root development, and seedling growth.

Therefore, this study aims to investigate effective methods for cultivating *Platycladus orientalis* L. seedlings and to evaluate the influence of different propagation techniques and substrates on their establishment and growth under the conditions of the southern districts of the Republic of Karakalpakstan.

2. LITERATURE REVIEW

The cultivation of drought-tolerant woody species has become increasingly important for afforestation and ecological restoration in arid regions. This issue is particularly relevant to the Aral Sea basin, where water scarcity, high temperatures, dry winds, and unfavorable soil conditions limit the successful establishment of woody vegetation. In this context, *Platycladus orientalis* L. is considered a promising evergreen species due to its ecological adaptability and relative tolerance to drought.

Previous studies have demonstrated that the growth and development of *P. orientalis* are closely related to water availability and environmental conditions. Che and Zhang [1] reported that the species exhibits considerable drought resistance, although its growth dynamics vary depending on precipitation and moisture conditions. Similarly, Sun et al. [6] and Zhao et al. [11] identified physiological mechanisms, including water-use regulation, root

development, and osmotic adjustment, that contribute to the adaptation of *P. orientalis* under drought stress.

Water management is particularly important during the early stages of seedling development. Zhang, Ma, and Lv [9] demonstrated that adequate re-irrigation can support the physiological recovery of *P. orientalis* seedlings following drought stress. These findings highlight the importance of selecting suitable irrigation regimes and growing substrates in arid nursery conditions.

Nutrient availability and soil properties also significantly influence the growth of *P. orientalis*. Xin [8] emphasized the importance of carbon, nitrogen, and phosphorus balance, while Du et al. [2] demonstrated the relationship between nutrient inputs and soil ecological processes. Other studies have highlighted the role of rhizosphere microorganisms and mycorrhizal fungi in improving nutrient uptake and plant adaptation [3, 4, 10].

Research has also shown that growth regulators and mineral fertilizers can positively influence seedling growth and development [5]. However, the effectiveness of these treatments depends on environmental conditions and cultivation technology. The sharply continental climate, limited precipitation, high temperatures, and soil conditions of the Amudarya district therefore require locally adapted approaches to seedling production.

The reviewed literature confirms the ecological adaptability and drought tolerance of *P. orientalis*. However, limited research has directly compared different propagation methods and substrate types under the specific soil and climatic conditions of southern Karakalpakstan. Therefore, experimental evaluation of seed propagation, transplantation, green cutting propagation, and different substrates is necessary to develop an effective technology for cultivating *P. orientalis* seedlings in the region.

3. MATERIALS AND METHODS

The study was conducted during the 2025–2026 growing seasons at the Qipchaq State Forestry Enterprise nursery in the Amudarya District of the Republic of Karakalpakstan. The experiment aimed to evaluate suitable propagation techniques and growing substrates for the cultivation of *Platycladus orientalis* L. seedlings under local soil and climatic conditions.

Three propagation approaches were investigated: seed sowing, transplantation of one-year-old seedlings, and propagation by green cuttings. Each method was tested using four substrates: peat, humus, sandy soil, and organically enriched light soil. The experiment was arranged in four replications, with one hundred planting units used in each experimental variant.

Stratified seeds were sown during the second decade of March at a depth of approximately 2–3 cm. Healthy one-year-old seedlings were transplanted into the respective substrates. Green cuttings measuring approximately 15–20 cm were collected from three-

five-year-old donor plants, prepared by removing foliage from the basal portion, treated with a rooting stimulant, and planted in the experimental substrates.

Seed germination, survival of transplanted seedlings, rooting success of cuttings, seedling height, and general phytosanitary condition were monitored throughout the study period. The experimental results were evaluated through comparative analysis to determine the propagation method and substrate that provided the most favourable conditions for seedling establishment and growth.

4. RESULTS

The experimental results obtained during 2025–2026 demonstrated that the propagation method and substrate type influenced the establishment and growth of *Platycladus orientalis* L. seedlings under the conditions of the Amudarya district.

Seed propagation produced the highest field emergence in peat, reaching approximately 65%. Lower values were observed in humus-rich material (55%), sandy soil (50%), and the organic-enriched soil mixture (45%). Under laboratory conditions, seed germination in peat reached approximately 95% at 25°C within 18–25 days. The difference between laboratory germination and field emergence indicates the influence of environmental conditions on seedling establishment.

The transplantation of one-year-old seedlings showed the highest establishment rate in peat (approximately 65%), followed by sandy soil (60%), humus-rich material (55%), and the organic-enriched mixture (50%). These results indicate that peat and sandy substrates provided favourable conditions for the establishment of transplanted seedlings.

Green cutting propagation showed comparatively lower efficiency. Rooting and survival ranged from approximately 30% to 45%, with the highest values observed in peat and the lowest in the organic-enriched soil mixture. This suggests that vegetative propagation through green cuttings requires further technological improvement under local nursery conditions.

Growth observations also revealed differences among substrates. Seed-propagated seedlings showed the greatest height development in peat, reaching approximately 18–25 cm by the end of the observation period. Transplanted seedlings achieved approximately 22–23 cm in peat and 20–22 cm in sandy soil. Plants propagated through green cuttings showed comparatively slower growth, generally reaching 10–14 cm.

Throughout the experimental period, established seedlings remained in satisfactory phytosanitary condition, with no serious disease or pest damage observed. However, the available data do not provide sufficient evidence to confirm the statistical significance of differences among treatments or to assess salt tolerance.

Peat demonstrated favourable conditions for seed propagation and seedling growth, while sandy soil showed promising results for transplanted one-year-old seedlings. Green cutting propagation was less effective and requires further optimization. These findings provide a preliminary basis for developing a differentiated technology for cultivating *P. orientalis* planting material under the environmental conditions of southern Karakalpakstan.

5. DISCUSSION

The results demonstrate that the successful cultivation of *Platycladus orientalis* L. seedlings under the conditions of the Amudarya district depends primarily on the propagation method and the properties of the growing substrate. The differences observed among the experimental variants reflect the biological

requirements of young plants under arid and continental environmental conditions.

Seed propagation showed favourable results, particularly in peat, where approximately 65% field emergence was recorded. The porous structure and moisture-retention capacity of peat likely created suitable conditions for seed germination and early seedling development. However, the difference between laboratory germination (approximately 95%) and field emergence confirms that seed viability and successful establishment under nursery conditions should be considered as separate biological indicators.

The transplantation of one-year-old seedlings also produced promising results. Peat and sandy soil supported successful establishment and growth, suggesting that seedlings with an already developed root system can adapt effectively after transplantation. From a practical perspective, locally available sandy soil may represent a more economically feasible alternative to peat, particularly for large-scale nursery production.

Green cutting propagation showed comparatively lower efficiency, with rooting rates ranging from approximately 30% to 45%. This result indicates that the applied technology requires further optimization. Factors such as the physiological condition of donor plants, cutting collection time, substrate moisture, air humidity, and the application of rooting regulators should be investigated in future experiments.

The results also emphasize the importance of using appropriate evaluation indicators for different propagation methods. Germination percentage should be applied to seed propagation, survival or establishment rate to transplanted seedlings, and rooting percentage to vegetative cuttings. This differentiation improves the scientific accuracy of the research.

Although the experimental soil had a neutral to moderately alkaline reaction, additional measurements, including electrical conductivity, soluble salts, nutrient availability, and organic matter content, are necessary for a comprehensive assessment of soil conditions. Similarly, further studies should include detailed statistical analysis based on primary replication data to determine the reliability of differences among treatments.

The findings confirm the potential of *P. orientalis* for nursery production under the environmental conditions of the Amudarya district. Seed propagation is suitable for producing large quantities of planting material, while the transplantation of one-year-old seedlings may provide stronger and more established plants. Green cutting propagation requires additional technological improvement before large-scale application. Further multi-site and economically oriented studies are necessary to develop a scientifically substantiated and regionally adapted technology for cultivating *P. orientalis* in southern Karakalpakstan.

6. CONCLUSION

The study demonstrated that the successful cultivation of *Platycladus orientalis* L. seedlings under the soil and climatic conditions of the Amudarya district depends on the propagation method and substrate type.

Seed propagation produced favourable results, particularly in peat, which provided suitable conditions for seedling establishment and growth. The transplantation of one-year-old seedlings was also effective, with peat and sandy or sandy-loam soils showing promising results. In contrast, green cutting propagation demonstrated comparatively lower efficiency and requires further optimization of rooting conditions, substrate composition, moisture management, and growth-regulating treatments.

The results confirmed the important role of substrate physical properties, particularly moisture retention, aeration, and root penetration, in seedling development. Throughout the experimental

period, the seedlings remained in satisfactory phytosanitary condition.

Platycladus orientalis demonstrated promising potential for nursery production under the environmental conditions of southern Karakalpakstan. The use of peat for seed propagation and peat or sandy substrates for transplanted seedlings can be considered promising approaches. Further experimental and multi-site studies are necessary to improve cultivation technology and evaluate the broader application of this species in afforestation and ecological restoration programs in the Aral Sea region.

DECLARATIONS

Author contributions CRedit

Conceptualization; Methodology; Investigation; Data curation; Writing – original draft; Writing – review & editing. All authors have read and agreed to the published version of the manuscript.

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Ethics approval

Not applicable. This study did not involve humans, animals or other regulated materials.

Informed consent

All authors have read and approved the final version of the manuscript and have given their consent to its submission and publication. The study involved no human participants and no personal data.

Data availability statement

All data supporting the findings of this study are presented in the article and are available from the corresponding author upon reasonable request.

Conflict of interest

The authors declare no conflict of interest.

Generative AI disclosure

Generative AI was used only partially. The authors used Claude (Anthropic, Opus 5) for language editing, formatting of the reference list and preparation of the English and Russian metadata. No text, data, figures or conclusions were generated by AI. The authors reviewed and verified all output and take full responsibility for the content of the publication.

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