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Cultivation of Saxaul Seedlings Using Water-Efficient Technologies to Improve Environmental Conditions and Prevent Sand Movement and Pasture Degradation

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Abstract: The deterioration of atmospheric air quality, the frequent exceedance of dust particle norms, and the acceleration of rangeland degradation processes necessitate urgent measures to address these challenges. The increasing frequency of sandstorms and their unhindered dispersion into the atmosphere and across rangelands significantly impact the ecological situation. This situation requires scientists to develop measures to both improve the ecosystem and prevent rangeland degradation. This article focuses on nature conservation and ecosystem improvement, discussing the research conducted by scientists at the Navoi Branch of the Academy of Sciences of the Republic of Uzbekistan. This research is aimed at establishing nurseries for the propagation of Saxaul (Haloxylon) to increase greenery in the country and consistently implement the “Yashil Makon” (Green Space) nationwide project, initiated by the President of the Republic of Uzbekistan.

Keywords: Saxaul (Haloxylon), rangelands, degradation, Yashil Makon (Green Space), suspension, seedlings, bioresources, bentonite clays, viability, and sandstorms

Introduction

Approximately 21 million hectares of the 44.9 million hectares of land area in our country consist of natural pastures. Natural pastures primarily play an important role in improving ecosystems in various regions and in the development of the national economy, especially in the livestock sector [1].

However, due to the improper use of pastures without adherence to necessary scientific recommendations and existing regulations—such as natural sand movement, technogenic impacts, overgrazing and unregulated livestock grazing, excessive exploitation of shrubs and certain plant species for household needs, geological exploration activities, extraction of underground mineral resources, and the construction of power lines and highways—the ecosystem has been deteriorating, and the degradation of pastures has been intensifying [2].

Therefore, the use of new technologies to protect pastures and promising forage plants from natural and anthropogenic factors has become an urgent task.

The Decree of the President of the Republic of Uzbekistan dated November 23, 2023 (No. PF-199) "On measures to ensure environmental sustainability by further increasing the level of greenery in the Republic and consistently implementing the nationwide project 'Green Space'" requires the implementation of large-scale activities aimed at restoring ecological balance in the country. In particular, extensive work is being carried out to establish green cover in the dried bottom of the Aral Sea and the Aral Sea region, as well as to create green belts in Bukhara and Navoi regions [3].

Methodology

The research was conducted using field experimental methods combined with descriptive and comparative analysis. Experimental studies on the cultivation of saxaul seedlings were carried out at a specialized nursery established in cooperation between the Navoi Branch of the Academy of Sciences of the Republic of Uzbekistan and "Anvar Elyor Omadi" LLC located in the Khatirchi district of Navoi region [4].

The nursery was established on a total area of **7 hectares**, where saxaul seedlings were cultivated using a water-efficient agrotechnology developed by scientists of the Navoi branch. The main objective of the experiment was to evaluate the effect of bentonite clay suspension used for foliar feeding on the growth, development, and viability of saxaul seedlings under arid environmental conditions [5].

The experimental design consisted of **two variants**:

- **Control variant** – cultivation of saxaul seedlings without the application of bentonite suspension (0.1 ha);
- **Experimental variant** – cultivation of saxaul seedlings with the application of bentonite clay suspension (6.9 ha).

The growth indicators of saxaul seedlings were monitored during different stages of the vegetation period, including **April, June, September, and November**. The main parameters observed during the experiment included seedling height, color of leaves, overall plant condition, and root system development [6].

The collected data were analyzed using comparative analysis to determine the effectiveness of the applied agrotechnological approach. The obtained results made it possible to assess the impact of bentonite suspension on plant growth, survival rate, and adaptability to desert environmental conditions.

To achieve this, it is essential to meet the increasing demand for seeds of desert plants and seedlings of shrubs for the establishment of saxaul-based "green shields" and cultivated pastures [7].

Through the establishment of "green shields," cultivated pastures, and saxaul shelterbelts, it is possible to afforest degraded pastures and thereby prevent the lifting of dust storms, sand, and salt particles into the atmosphere. This contributes not only to the creation of green belts in these regions but also has a positive impact on human health [8].

The saxaul plant plays a significant role in the establishment of green shields and cultivated pastures. It is mainly used as fuelwood, as nutritious forage for sheep and camels, and as a natural barrier that stabilizes sand and reduces wind erosion.

Saxaul plantations play an important role in protecting soil from erosion. The saxaul tree can live for 50–60 years, reproduces mainly by seeds, and begins normal seed production within 5–7 years. In Central Asia and Kazakhstan, saxaul forests cover approximately 22 million hectares. In Uzbekistan, saxaul forests occupy about 1,229 thousand hectares, including 976 thousand hectares of white saxaul and 253 thousand hectares of black saxaul [9].

In our region, attempts to establish cultivated saxaul plantations have almost disappeared today due to insufficient protection of seedlings from livestock grazing and their use as firewood by local residents.

To ensure the implementation of the nationwide "Green Space" program, it has been planned to plant 6–7 million saxaul seedlings annually in Navoi region [10].

The activities carried out within the framework of the nationwide “Green Space” project and the “Uzbekistan–2030” strategy are directly aimed at restoring desert pastures and preventing soil degradation. Modern scientific literature demonstrates that the establishment of “cultivated saxaul plantations” and the creation of specialized nurseries can contribute not only to environmental sustainability but also to preventing soil degradation and improving the forage base of pastures.

In the article “Technologies for Growing and Planting Saxaul Seedlings: The Experience of Uzbekistan,” published in the *Modern Science and Research* journal, the practical importance of using resource-efficient methods in the cultivation of saxaul seedlings is explained. The article also analyzes innovative local approaches to improving the development of the root system of saxaul seedlings and increasing their adaptability to arid land conditions [11]

Results and Discussion

In order to ensure the implementation of this program, conduct relevant experiments, and protect the pastures located in the desert foothill regions of Navoi region from degradation, a number of research activities are being carried out by scientists of the Navoi branch of the Academy of Sciences [12].

In 2025, based on a cooperation agreement between the Navoi branch and the “Anvar Elyor Omadi” LLC located in Khatirchi district, a specialized nursery for growing saxaul seedlings was established on an area of 7 hectares. In this nursery, saxaul seedlings are cultivated using a new agrotechnology developed by the scientists of the branch.



Figure 1. Stages of saxaul seedling development in the experimental plot, from germination to the stage of ready seedlings.

In the nursery, experimental studies were conducted to determine the effect of cultivating saxaul seedlings using a new agrotechnological approach and applying a bentonite suspension for foliar feeding during the first growing season on plant growth and development [13].

The experimental research was carried out in two variants:

- Control variant – without the application of suspension (0.1 ha area),
- Experimental variant – with the application of suspension (6.9 ha area).

According to the results of the study, the seedlings in the control plot had yellowing leaves and reached a height of 35–40 cm, whereas the seedlings in the experimental plot were healthy and had an average height of 55–60 cmv[14].

The results of the experimental trials showed that in the plots where bentonite clay suspension was applied, the saxaul seedlings developed stronger root systems, the seedlings remained healthy, and their average height was approximately 20 cm higher compared to the control plot [15].

Table 1. Growth indicators of Saxaul seedlings under different agrotechnical conditions.

Variant	Area (ha)	April	June	September	November	Seedling Condition
Experimental	6.9	18-25	32-35	45-54	55-60	Light green
Control	0.1	15-24	26-28	31-35	35-40	Yellowing

Conclusion

In conclusion, the establishment of nurseries for cultivating saxaul seedlings and the production of healthy, high-yield seedlings using new agrotechnologies represent a consistent step toward ensuring environmental sustainability through the systematic implementation of the nationwide “Green Space” project.

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