

## ANNOTATION

**Dissertation work the «Improvement of agricultural techniques for growing Black saxaul in Western Kazakhstan» Akhmetov Ruslan, presented for the degree of Doctor of Philosophy (PhD) in the educational program 8D08302 – Forest Resources and Forestry**

### Relevance of the Research Topic

Of the species growing in the desert forests of Kazakhstan, black saxaul (*Haloxylonaphyllum (Minkw)*) is the most valuable. Long-term, and sometimes excessive, exploitation of saxaul stands has led to a significant reduction in their area. Therefore, the main objective of silvicultural work here is to take the necessary measures to expand the area under saxaul plantations and ensure their sustainability.

The need to expand the area of saxaul stands is particularly pressing in the western region of Kazakhstan, where long-term and excessive use of black saxaul for fuel without measures for natural conservation Regeneration, coupled with uncontrolled grazing, has led to the almost complete destruction of saxaul stands over large areas and reduced the productivity of the remaining saxaul forests.

It is necessary to develop a technology for forest plantation cultivation that takes into account forestry and agricultural interests and allows for the simultaneous production of timber and the improvement of pastures.

One of the fundamental requirements for protective forest plantations is their biological and ecological sustainability, as well as their longevity.

Creating sustainable and long-lasting protective forest plantations in the arid conditions of western Kazakhstan remains a serious challenge due to the sharply continental climate and its changes, the wide range of soil plant properties, poor agricultural practices, and the lack of measures for their maintenance and protection.

Therefore, identifying the best methods for their creation requires the development of more rational and improved cultivation and care technologies that ensure the formation and enhancement of their melioration and ecological properties. Efficiency.

Scientists have shown that 1 hectare of 4-year-old saxaul absorbs 1,158.2 kg of carbon dioxide and releases 835.4 kg of oxygen.

Many scientists note the difficulty of establishing saxaul stands in difficult forest conditions, where their establishment is not always successful.

Research to improve agricultural technology for establishing saxaul plantations in the western region of Kazakhstan and to determine optimal methods for their establishment will allow for the development of more resilient, durable, and effective protective forest crops for production.

By 2022, the Samsk and Beineu State Forest and Wildlife Protection Departments of the Department of Natural Resources and Environmental

Management of the Mangystau Region established forest plantations using seed sowing on a total area of 7,670 hectares. 5,787.8 hectares, or 75.46%, were written off, and only 1,882.2 hectares, or 24.54% of forest plantations. Technology for creating black saxaul forest plantations by planting seedlings is lacking in the Western region of Kazakhstan.

By solving the stated objectives, a regional technology for creating saxaul plantations by planting seedlings will be developed, contributing to an increase in forest cover in the arid territories of Western Kazakhstan.

**The objective of this study** is to develop a scientifically sound technology for the artificial creation of saxaul plantations by planting 1-year-old seedlings with minimal labor and resources, ensuring high survival rates, growth rates, and development of the plantations.

### **Research Objectives.**

This study aims to:

- Study and analyze materials on the technology for creating black saxaul forest plantations in the Western region of Kazakhstan.
- Study and analyze materials on cultivation technology, and conduct a reconnaissance survey of black saxaul forest plantations and other desert plants created by the State Forestry Department;
- Survey of artificial black saxaul plantations in the Mangystau and Atyrau Oblast;
- Study of soil conditions by plotting soil pits to determine the suitability of the area for forestry;
- Effect of timing of establishment of black saxaul forest plantations on plant growth and development;
- Study of the effect of canopy width and number of rows on the survival rate and growth of black saxaul plantations in the Mangystau Oblast;
- Study of the growth and development of black saxaul plantations established using various soil cultivation methods in the Mangystau and Atyrau Oblasts;
- Study of the effect of planting density and number of rows on the survival rate and growth of black saxaul in the Atyrau Oblast;
- Study of the growth and development of black saxaul and herbaceous vegetation depending on the frequency of agronomic treatments;
- Use of growth stimulants and adsorbents to establish black saxaul forest plantations;
- Formation of a microclimate in black saxaul forest plantations.

### **Research Methods**

The reconnaissance survey of saxaul stands aims to provide a general geobotanical characterization of the surveyed area. It was conducted to obtain an initial understanding of the natural conditions and vegetation cover of the region. This type of research is descriptive, without a detailed study of individual associations.

The study and analysis of the current state and growing conditions of the site was conducted through a detailed geobotanical route survey. These studies aim to provide a more complete characterization of the plant associations and formations in the study area. This characterization can be obtained by laying out a series of routes with systematic recording of vegetation along their course, a detailed description, and consideration of phytocenoses.

The soil survey was conducted according to the instructions of the State Committee of the Republic of Kazakhstan on Land Relations and Land Management.

The research utilized the methodological recommendations of V.V. Ogievsky and A.A. Khirov.

The selection and description of a sample plot should be accompanied by familiarization with the surrounding area and, if necessary, additions and adjustments to the data obtained from the sample plots. Sample plots are marked with labels and tied to a permanent landmark.

Saxaul survival is determined during the autumn crop inventory.

For each planting type or plot, three sample plots are established, where survival, height, crown projection diameters along and across the row, and condition are determined.

The height of bushes up to three years of age is measured with a measuring rod with an accuracy of 1 cm, and the height increment of the crops is determined using the method of A.A. Molchanov and V.V. Smirnov.

Saxaul survival is determined by a complete count of the bushes in the sample plots for each strip or variant after the end of the growing season. The condition of saxaul plants in all sample plots is assessed using the scale of G.G. Vibe.

A study of the dynamics of weed emergence and decline is conducted using the methodological developments of N.P. Remezov, L.E. Rodin, and N.I. Bazilevich, and their description is based on the Drude scale.

Weed counts are conducted every 15 days in the spring and every month in the summer. The projective cover is determined visually using a grid (10 x 10 cm mesh) with an accuracy of 10%. Weed species occurrence is determined as a percentage.

#### **Thesis proposals submitted for defense:**

- The influence of the establishment timing, planting density, and number of rows of black saxaul forest plantations on plant survival and growth;
- A study of the survival and growth of black saxaul plantations created using various soil cultivation methods, canopy widths, and number of rows;
- A study of the growth and development of black saxaul and herbaceous vegetation under the application of agricultural practices;
- Study of the use of moisture-absorbing substances and growth biostimulants in the development of black saxaul forest plantations;
- Study of the microclimate in black saxaul forest plantations.

## **Description of the main research findings**

The best results are achieved with deep plowing (up to 40 cm), which increases survival by 6.3-19.4% and growth by 5.5-28.6% compared to shallow tillage. A three-row coffered system with a width of 11.2-12.0 m, with seedlings spaced 1.5-2.0 m within the row, is optimal.

Planting should be carried out in the first ten days of April. A delay of one ten-day period reduces survival by 5.2-17.9%. Cultivation management is critical, especially during the first year. Three-time inter-row weed treatments at monthly intervals (May-July) ensure 100% weed control and increase growth by 31.2% compared to the control.

The proposed technology (including three-row planting, deep plowing, and intensive care) is cost-effective. It reduces the cost of establishing 1 hectare of crops by 22,336.2 tenge, and with an annual volume of 100 hectares, savings of 2,233,620 tenge are achieved. The use of mechanization reduces manual labor costs by 5-6 times.

## **Justification of the Novelty and Importance of the Obtained Results**

The scientific novelty of this dissertation lies in the fact that, for the first time in the arid conditions of western Kazakhstan (Atyrau and Mangystau regions), a regional technology for establishing black saxaul forest crops by planting seedlings with the use of moisture-absorbing substances and growth stimulants has been developed.

The recommended set of agronomic practices ensures high survival rates and intensive growth of saxaul crops, making it economically feasible for restoring pastures in the arid conditions of western Kazakhstan.

## **Correspondence with scientific development trends or government programs**

The research results are fully consistent with the sustainable development of the agro-industrial complex of the Republic of Kazakhstan. The work aligns with the objectives of rational natural resource management defined in the "Kazakhstan 2050" Strategy, as well as with the goals of the "Green Kazakhstan" national project and government programs for the development of the agro-industrial complex. The obtained scientific results contribute to combating desertification and land degradation, preserving and restoring biodiversity, and improving soil water management.

## **Description of the doctoral student's contribution to the preparation of each publication**

In preparing each publication, the doctoral student was directly involved in selecting the research topic, collecting materials and data, analyzing and processing them, systematizing and formulating the scientific results. Additionally, the doctoral student wrote the main sections of the articles, conducted a literature review, formulated conclusions, and prepared the manuscript for publication.

Fifteen articles have been published on the topic of the dissertation, including: four articles in a journal recommended by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan; two articles in an international scientific journal included in the Scopus database; and nine articles in the proceedings of international conferences. There is also a Certificate of Implementation of the Results of Research, Scientific and Technical, and/or Experimental Design Work in Production on the Territory of the State Forest Fund "Samsk KSU for the Protection of Forests and Wildlife" covering an area of 15.9 hectares.

**The scope and structure of the dissertation.** The dissertation is 121 pages long and consists of an introduction, 4 sections, a conclusion, and appendices. It contains 22 tables and 45 figures. The list of references includes 94 titles.