

DOI: 10.58168/SAS2025_241-248

УДК: 630*232

STUDY OF GEOGRAPHICAL VARIABILITY USING THE EXAMPLE OF TEST CROPS OF PINUS SYLVESTRIS L. IN THE KHRENOVSKY FOREST

ИЗУЧЕНИЕ ГЕОГРАФИЧЕСКОЙ ИЗМЕНЧИВОСТИ НА ПРИМЕРЕ ОПЫТНЫХ КУЛЬТУР PINUS SYLVESTRIS L. В ХРЕНОВСКОМ БОРУ

Пивоваров М.В., аспирант, ФГБОУ **Pivovarov M.V.**, postgraduate student, ВО «Воронежский государственный Voronezh State University of Forestry лесотехнический университет им. and Technologies named after Г.Ф. Морозова», Воронеж, Россия. G.F. Morozov, Voronezh, Russia.

Цепляев А.Н., доктор **Tseplyaev A.N.**, Doctor of сельскохозяйственных наук ФГБОУ Agricultural Sciences, Voronezh State ВО «Воронежский государственный University of Forestry and лесотехнический университет им. Technologies named after Г.Ф. Морозова», Воронеж, Россия. G.F. Morozov, Voronezh, Russia.

Abstract: The study of the geographical variability and population structure of the common pine (*Pinus sylvestris* L.) is an important area in dendrology, genetics, and forest breeding. This problem is relevant due to the need to preserve the genetic diversity of the species, increase productivity and resilience of forest ecosystems to changing climatic conditions. Geographical pine crops established in various regions allow us to explore the adaptive capabilities of woody plants to new environmental conditions, as well as to identify patterns of influence of climatic factors on the growth and development of stands. This article discusses the

main methods and results of research of geographical cultures and *Pinus sylvestris* L. in the Khrenovsky forest.

Keywords: geographical variability, *Pinus sylvestris*, forest breeding, genetics, height, diameter, correlation.

Аннотация: Изучение географической изменчивости и структуры популяции сосны обыкновенной (*Pinus sylvestris* L.) представляет собой важное направление в дендрологии, генетике, лесной селекции. Эта проблема актуальна в связи с необходимостью сохранения генетического разнообразия вида, повышения продуктивности и устойчивости лесных экосистем к изменяющимся климатическим условиям. Географические культуры сосны, заложенные в различных регионах, позволяют исследовать адаптационные возможности древесных растений к новым условиям среды, а также выявить закономерности влияния климатических факторов на рост и развитие древостоев. В данной статье рассматриваются основные методы и результаты исследований географических культур и *Pinus sylvestris* L. в Хреновском бору.

Ключевые слова: географическая изменчивость, *Pinus sylvestris*, лесная селекция, генетика, высота, диаметр, корреляция.

Introduction

The study of the geographical variability of tree species is of crucial importance for population genetics, as it allows us to understand the patterns of formation of gene pools of plantations of the main forest-forming species in various climatic conditions. From the point of view of forestry, such studies make it possible to clarify forest-seed zoning and optimize the use of non-district seeds, which will increase the productivity of forest plantations [1, 2, 5].

The main method of studying geographical variability is the creation of specialized crops, monitoring the growth, which will allow for a comparative assessment of the biological productivity of seed offspring of different origins [3].

The geographical pine crops in 515 block of the Khrenovsky forestry

(Voronezh region) were established in 1964-1965 under the leadership of forester D.G. Dynin. The choice of a place for the creation of crops was due to the need to create an educational facility in the immediate vicinity of the academic building, in optimal conditions for the growth of common pine. The land area was 0.68 ha. The planting material for the creation of crops was grown from seeds provided to Melon by D.G. Professor A.V. Albensky and graduates of the Khrenovsky College. The initial data for the study, including historical information, the layout of climatypes, survival rates, and preservation, were provided from the archival records of D.G. Dynin [4].

The type of forest conditions (TL) on the site is represented by variants B1 and B2. The terrain is slightly undulating, with a slight depression in the center of the site. The slope on which crops from seeds obtained from Chita, Kaliningrad and Ryazan are planted has a slope of 15° and a north-western exposure.

In the spring of 1964, partial plowing with a two-shaft tractor plow was carried out on the indicated forest area to a depth of 15 cm with the formation of strips 1.5-2.0 m wide. Common pine crops were created pure in composition, and hanging birch was planted as dividing curtains between the groups. The total number of pine seedlings planted was about 10,000 with an estimated density of 16,000 per 1 ha [4].

Materials and methods

The study of the geographical cultures and population structure of the common pine (*Pinus sylvestris* L.) involves the use of an integrated approach aimed at analyzing the morphological, taxation and genetic characteristics of trees, as well as their adaptive potential in various environmental conditions [6].

The main methodological approaches include:

a) conducting a continuous enumeration of trees in steps of thickness with a record of height, diameter and other biometric indicators. For in-depth analysis, model specimens are selected, in which the height and length of the crown are

measured, and cores are also taken to assess the radial growth and thickness of the crust. Additionally, the bonus class and other tax characteristics are determined. The reliability of the data obtained is verified using statistical methods, including variance, correlation, and multifactorial analyses [5].

b) the study of the climatic parameters of the initial regions (the sum of active temperatures, precipitation, duration of the growing season, etc.) and their impact on the growth and development of experimental crops. The comparison of taxation indicators with climatic conditions makes it possible to assess the level of adaptation of tree species to new habitats [3].

c) the use of laboratory and statistical methods of data processing, contributing to the identification of mechanisms of adaptation and intraspecific differentiation, as well as the development of scientifically sound recommendations for sustainable forest management [2, 7]. These methods were used in the study of geographical cultures in the Khrenovsky forest.

The results of the study

The analysis of biometric indicators of the common pine (*Pinus sylvestris* L.) of various geographical origin in geographical cultures of the G.F. Morozov Khrenovsky Forestry College revealed statistically significant correlations between geographical coordinates (latitude and longitude) and the taxation indicators of the common pine, including the diameter and height of trees.

1. The effect of longitude on diameter and height. An average negative correlation was found between longitude and diameter ($r = -0.63$). A similar trend is observed for height, but the coupling strength is weak ($r = -0.36$). These dependencies indicate a decrease in the morphometric parameters of trees as the longitude of the seed collection site increases.

2. The influence of latitude on diameter and height. The strongest negative correlation was found between latitude and diameter ($r = -0.85$). For height, the dependence is also significant ($r = -0.51$). The results obtained confirm the tendency to decrease the diameter and height of trees with an increase in the

latitude of the location of the initial population.

3. The analysis revealed statistically significant negative correlations between the stock of wood and geographical coordinates. A moderate negative dependence has been established for latitude ($r = -0.46$), which indicates a tendency to decrease the productivity of the climate type as the seed harvesting sites move northward. For longitude, a weak negative correlation ($r = -0.37$) with the wood stock was found.

Currently, the diameter of the trunk is highly correlated with the average annual temperature of the seed harvesting site ($r = 0.8$), and the height is highly correlated with the temperature ($r = 0.5$).

The following ecotypes are currently highly complete: Brest, Khrenovsky, Tambov, Kaliningrad, Gomel, Ryazan, etc. Low completeness is typical for the following ecotypes: Aldan, Olekmen, Tyumen, Komi, Chita, which belong to the northern and eastern populations. The ecotype represented by the Crimean pine was severely depleted after the death of the pine as a result of severe frosts in 1972 and is currently represented by several specimens.

Conclusion

A study of the geographical crops of Scots pine (*Pinus sylvestris* L.) in the Khrenovsky forestry and an analysis of their taxation indicators depending on geographical coordinates revealed a number of patterns. It has been established that the diameter, height and stock of pine wood demonstrate a statistically significant negative correlation with latitude and longitude, which indicates the continued pattern of more intensive growth of climatotypes from favorable conditions for pine growth. The greatest dependence was found between latitude and diameter ($r = -0.85$), which confirms a significant decrease in tree size as the populations in which seeds were harvested moved north. A similar, though less pronounced, trend is observed for longitude ($r = -0.63$ for diameter and $r = -0.36$ for height).

To deepen the results obtained and expand the practical application of these

studies, it is advisable to focus on the following areas: studying the influence of microclimatic and soil factors on the growth of geographical crops, conducting genetic analysis to identify adaptive traits in various ecotypes, as well as monitoring the dynamics of plant growth in a changing climate. Special attention should be paid to restoring lost crop markings and detailed mapping of preserved ecotypes to ensure long-term monitoring. The data obtained can be used to optimize forest-seed zoning and develop recommendations for the creation of sustainable forest crops, taking into account their geographical origin.

References

1. Bastaeva G.T. Study of the growth of geographical cultures of scots pine in the Samara region / G.T. Bastaeva, A.Y. Skrylnikova, D.Y. Myachina // *Izvestiya Orenburg State Agrarian University* 2013 pp. 31-33.
2. Vidyakin A.I. Phenetics, population structure and conservation of the genetic fund of the common pine / A.I. Vidyakin // *Conifers of the boreal zone*, XXIV, No. 2-3, 2007 pp. 159-166.
3. Solomnikov A.A., Shiryaev V.A. A study of the growth of geographical pine crops in the Bryansk region. Actual problems of the forest complex / Edited by E.A. Pamfilov. Collection of scientific papers based on the results of the international scientific and technical conference. Issue 12. Bryansk: BGITA, 2005. pp.56-57.
4. Tseplyaev A.N. Chemotypic variability and micropopulation structure of indigenous pine forests of the Khrenovsky forest and its significance for reforestation / A.N. Tseplyaev, E.I. Treshchevskaya // *Voronezh VGLTU* 2019 – 120 p.
5. Chernodubov A. I. Geographical cultures of the common pine in the south of the Russian plain. / A. I. Chernodubov, T. E. Galdina, O. A. Smogunova // *Voronezh*, 2005. 128 p.
6. Mikhailova, M. I. Features of the structure of geographical forest crops of common pine in diameter / M. I. Mikhailova, M. P. Chernyshov // *Forestry*

Journal. – 2021. – Vol. 11. – № 1 (41). – Pp. 46-55. – Bibliogr.: pp. 53-55 (18 titles). – DOI: 10.34220/issn.2222-7962/2021.1/4.

7. Chernyshov M.P. Geographical forest cultures of the common pine in the Central Chernozem region / M.P. Chernyshov, M.I. Mikhailova // Voronezh. IN THE DARKNESS. 2024. – 196 p.

Список литературы

1. Бастаева Г.Т. Исследование роста географических культур сосны обыкновенной в условиях Самарской области / Г.Т. Бастаева, А.Ю. Скрыльникова, Д.Ю. Мячина // Известия Оренбургского государственного аграрного университета 2013 С. 31-33.

2. Видякин А.И. Фенетика, популяционная структура и сохранение генетического фонда сосны обыкновенной / А.И. Видякин // Хвойные бореальной зоны, XXIV, № 2 - 3, 2007 С. 159-166.

3. Соломников А.А., Ширяев В.А Исследование роста географических культур сосны в Брянской области. Актуальные проблемы лесного комплекса / Под ред. Е.А. Памфилова. Сборник научных трудов по итогам международной научно-технической конференции. Выпуск 12.– Брянск: БГИТА, 2005. С.56-57.

4. Цепляев А.Н. Хемотипическая изменчивость и микропопуляционная структура коренных сосняков Хреновского бора и ее значение для лесовосстановления / А.Н. Цепляев, Э.И. Трещевская // Воронеж ВГЛТУ 2019 – 120 с.

5. Чернодубов А. И. Географические культуры сосны обыкновенной на юге Русской равнины. / А. И. Чернодубов, Т. Е. Галдина, О. А. Смогунова // Воронеж, 2005. - 128 с.

6. Михайлова, М. И. Особенности строения географических лесных культур сосны обыкновенной по диаметру / М. И. Михайлова, М. П. Чернышов // Лесотехнический журнал. – 2021. – Т. 11. – № 1 (41). – С. 46–55. – Библиогр.: с. 53–55 (18 назв.). – DOI: 10.34220/issn.2222-7962/2021.1/4.

7. Чернышов М.П. Географические лесные культуры сосны

обыкновенной в Центральном Черноземье / М.П. Чернышов, М.И.
Михайлова // Воронеж. ВГЛУ. 2024. – 196 с.