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CLIMATYPE BREEDING FEATURES OF *Pinus sylvestris* L. cv. Negorelskaya

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***Abstract**. How can a new cultivar of Pinus sylvestris* L. cv. Negorelskaya*, ecologically sustainable and with increased productivity, be obtained by breeding 65 climatypes of Scots pine? The breeding of cultivars of higher plants has always been of interest and often occurred during the succession of several generations of scientists. The first generation of scientists founded the primary in 1959, and the secondary provenance trial plantation in 1965. The second generation continued the breeding process and received a breeder's patent in 2014. The first seed production of clones of Pinus sylvestris* L. cv. Negorelskaya *on a grafted forest-seed plantation begins at the age of 5; at the age of 15-17, the actual yield of varietal seeds on a hybrid-seed plantation is 11-15 kg per 1 ha.*

Keywords: climate change, Pinus sylvestris L. cv. Negorelskaya, plant climatype, population breeding, provenance trial plantation.

INTRODUCTION

The Scots pine (*Pinus sylvestris* L.) has the world's widest range of vegetation (intrazonality) and economic use of plantings both in its natural form and in forest crops.

P. sylvestris grows on quite different types of soils, including sandy and rocky ones, due to the natural aerial seeding [1], which is carried out in its natural form due to the peculiarities of the physiological structure of the seed, which has a filmy wing. Physiologically, *P. sylvestris* seeds are similar in light [2], that is, there is no need for seeds to be embedded in the soil to initiate the germination mechanism by genes. Moreover, in the absence of lighting, the germination process

is inhibited. Therefore, the seed, having reached the crevice between the stones, and catching a portion of photons of solar radiation during the day, germinates, becomes fixed and continues to develop as a plant.

Due to the gradual warming of the climate [3], many international grant projects for the restoration of agroforestry landscapes are planning a roadmap for future experiments with coniferous plants, based on the principle of "moving seeds along the climatic gradient [4,5]", and, accordingly, the latitude–longitude gradient, from the place of growth to the place of experiment, most often from areas with a higher average annual temperature in a zone with a lower average annual temperature [5].

The conservation of genetic resources [6], as well as the breeding process of new Scots pine cultivars, are always based on the desire to ensure the best productivity and stress resistance of the future plant.

An interesting method of breeding *P. sylvestris* for obtaining new cultivars is the selection of seed sources according to provenance and the creation of a primary provenance trial plantation from selected individuals [7].

Firstly, when observing the ontogenesis of different *P. sylvestris* climatypes, it is possible to select the most promising climatypes based on the high level of genetic variability, which consists of the levels of variability in the stands of the donor regions of reproductive material. Secondly, it is possible to select according to the degree of resistance of climatypes to the influence of limiting environmental factors of the acceptor region. Thirdly, it is possible to select according to productivity and basic biometric indicators. The application of breeding methods [8,9] in the practice of forestry will make it possible to increase the productivity and environmental sustainability of the created stands.

We will demonstrate the peculiarities of breeding the cultivar of the common pine "Negorelskaya" based on climatypes.

MATERIALS AND METHODS

In 1958, enterprising young scientists, Vasily Grigorievich Mishnev, a geobotanist, and Evgeny Dmitrievich Mantsevich, a specialist in the field of forest breeding, who worked at the Belarusian State Technological University (Minsk, Belarus), agreed on the issue of obtaining 200 different seed lots of *P. sylvestris* with the Central Control Station of Forest Seeds and the Belarusian Control Station of Forest seeds. After conducting a thorough forest typological analysis of the obtained seed batches, they selected 65 experimental batches of seeds collected in the most characteristic locations, from 48° to 62° north latitude and from 22° to 111° east longitude.

In 1959, in the Dzerzhinsky district of the Minsk region, on the territory of the Negorelsky Educational and experimental forestry of the Belarusian State

Technological University, a rectangular primary provenance trial plantation was established, elongated from north to south.

Topologically, geographical crops, including separate plots with an area of 0.1 hectares (40×25 m) of each of the 65 climatypes presented, are arranged as follows: from north to south – plots with seeds from large climatic regions, from west to east – according to the greatest geographical difference.

Geomorphologically, the site of geographical crops was a site after logging, where cultural and technical land reclamation was carried out with the uprooting of stumps and harvesting of felling residues, leveling the surface and plowing the cohesive sandy soil to a depth of 25 cm.

Annually, agrotechnical maintenance was carried out at the primary provenance trial plantation to remove weeds and improve gas exchange by mechanically loosening the soil with a special unit.

In 1965, on test-sites for *P. sylvestris* crop climatypes: Belgorod's (the sum of effective accumulated temperatures above 5.0 °C GDD5 = 2600; hydrothermal coefficient GTK = 1.3), Voronezh's (GDD5 = 2800; GTK = 1.2), Saratov;s (GDD5 = 3200; GTK = 0.8), Kirov's (GDD5 = 1800; GTK = 1.4) and Minsk's (GDD5 = 2550; GTK = 1.7) provenances [10] only female flowering was observed, therefore, a secondary provenance trial plantation was laid from the harvest of hybrid seeds (from pollination between each group and background pollen from the local *P. sylvestris* stand).

A detailed description of the breeding process from the climatypes of the Negorelskaya cultivar is presented by S.V. Rebko and co-authors [10], published in the journal "Botany. Research" at the V. F. Kuprevich Institute of Experimental Botany of the National Academy of Sciences of Belarus (Minsk). The variety has been included in the State Register of Tree and Shrub Varieties of the Republic of Belarus since 01.01.2014, and co-authors S. Rebko and L. Poplavskaya received a breeder's certificate.

RESULTS AND DISCUSSION

The appearance of any cultivar is always associated with lengthy field experiments and causes extensive discussion, especially in matters of productivity.

From observations of plant growth and development, it has been established that the Negorelskaya cultivar is characterized by early and abundant seed production (the first seed production of clones on a grafted forest-seed plantation begins at the age of 5; at the age of 15-17 years, the actual yield of varietal seeds on a hybrid seed plantation is 11-15 kg of seeds per 1 ha), the presence of unusual cluster-like seed production for the common pine as one of the signs of reproductive heterosis (there may be from 3 to 32 cones in one bunch), more intensive growth of varietal offspring in test crops (an increase in height It can reach up to 50-80 cm in

one growing season).

For comprehensive research of the Negorelskaya cultivar, various experimental plantations have been established in the Minsk region over the years, the most extreme of which is in the Educational and Experimental Forestry of the Voronezh State Forestry University [11] (Voronezh Region, Russia) in the fall of 2023, in the spring and autumn of 2024, an experimental plantation of seedlings with closed roots produced from 1200 seeds of the Negorelskaya cultivar with known gravimetric and optometric characteristics within the framework of the Russian Science Foundation, grant 23-26-00228, included in the technological passport "seed – culture" [11].

An interesting question may be the question of the degree of reproduction of full-fledged seeds (sound seed) by plants of the Negorelskaya cultivar, as well as the effect of the seed coat color [14].

As shown by M. Sourso [12], the inbreeding coefficient of higher coniferous plants varies greatly when moving along the gradients of latitude and longitude, therefore, the number of germ-free seeds [13], unable to germinate, could have strong variability in experimental batches of geographical crops.

It would be interesting in future research by data [15] to consider the geographical seed plantation used for the breeding of the Negorelskaya cultivar according to the indicator (coefficient F) of inbred depression: how much and in what direction it has changed in geographical crops since the establishment of the forest-seed plot over 65 growing seasons.

CONCLUSIONS

Breeding according to the climatypes of the Scots pine species provides sufficiently hardy and productive offspring, characterized by cluster-like fruiting, as well as increased activity of growth processes, which is not characteristic of *P. sylvestris* plants in natural habitats.

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