

УДК 630*232

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SELECTIVE BREEDING OF SCOTS PINE IN POLESSKY FOREST SEEDING DISTRICT

This paper presents data on the structure of the permanent base pine ordinary in Polesky forest seeding district. The study conducted growth of pine ordinary created planting different breeding groups. Clonal plantations of pine ordinary in Polesky forest seeding district is 42.2% of pine plantations established in Belarus. The proportion of seeds harvested from clonal plantations in Polesky forest seeding district area is 18.3%, which is 2 times higher than the figure for the whole of Belarus. Forest cultures created of selection material in Polesky forest seeding district area was 27.2%, share of the Republic of cultures – 31.9%.

Introduction. Seed propagation of improved selective planting material of the main forest forming species is connected with forest seed breeding system. At present time forest breeding turned out to be one of the main branches of silvicultural activity, targets of which are mass production of seeds of forest wood species with valuable hereditary properties, their preparation, processing, storage, sale, seed control, preservation and researches on valuable gene pool of forest plants. The main method of modern forest breeding is plus breeding method, having both advantages and disadvantages. One of the disadvantages is destabilization of created forest plantations. Best plus trees are selected according to essential criteria, and most often according to their speed of growth. However such selection, in the eyes of some scientists, reduces the level of polymorphic.

In the process of creation of artificial forest plantations on genetic-breeding basis, the main target is growing plants with stably high agronomic utility characters, and high resistance to abiotic and biotic factors.

The goal is reached by two factors: individual genotype's homeostasis and system homeostasis of population that consists of certain number of genotypes. The possibility of using individual homeostasis has been proved by clonal breeding. The natural populations which have been well adapted for specific conditions of the environment are an example of a population homeostasis.

It's known that artificial plantations that were created from local seeds are more adapted to the local environment conditions. In this regard the following task is set: creation a constant forest seed base in forestry station on the basis of the best trees and plants allocated in the same forestry, and taking into account forest vegetation conditions.

Main part. In Belarus the main objects of the constant forest seed base that allow to receive seeds with improved hereditary properties are clonal forest seed orchards.

Plus or elite trees can be an initial material for forest seed plantations establishment: trees from

one population; from different populations of one edaphotype; from different edaphotypes of one climatype; from different climatotypes if one kind; from climatotypes of different kinds. Selection of plus trees for reproduction on a seed plantation should be carried out taking into account the forest seed area and types of conditions of a habitat. It is recommended to unite the trees growing in similar fertility and humidity habitat conditions within a forest seed area. In the conditions of Belarus it's possible to distinguish following groups of habitat conditions type, according to which plus trees can be allocated together: 1 – A₀, A₁, B₀, B₁; 2 – B₂, B₃, A₂, A₃; 3 – C₂, C₃, D₂, D₃.

According to forest seed division into districts on the territory of Belarus, there are two forest seed areas for Scots pine: Belorussky and Polesky. Polesky forest seed area includes Brest and Homel regions. The change of vegetation in these areas is directly connected with the change of climatic conditions, and first of all air humidity. Besides, these regions in comparison with other territory of Belarus are characterized by longer vegetative period, a smaller amount of precipitation and higher average air temperature. The combination of such climatic factors allows to form here peculiar vegetable communities.

In the territory of the Polesky forest seed area there are concentrated more than 50% of the valuable gene pool of the main forest forming wood species represented by plus trees, plus plantings and genetic reservations. A considerable part of the gene pool takes the share of Scots pine. For example, the share of pine plus trees of the Polesky forest seed area makes 37% of all pine plus trees allocated on the territory of Belarus, and 53% of plus trees of all forest forming wood species of the Polesky forest seed area.

The local populations represented by plus plantings and genetic habitats are of great value for breeding. In the territory of the Polesky forest seed area there are 209.4 hectares of pine plus plantations and 478 hectares of genetic habitats (Table 1).

Table 1
The objects of constant forest seed base
of Polesky forest seed area

Objects list	Total quantity	Pine trees among them
Plus trees, pcs.	1117	596
Plus plantings, ha	507.7	209.4
Plus forest seed plantations, ha	228.8	17.0
Tree seed orchard, ha, incl.:	466.0	369.2
– 1 st generation	343.3	261.2
– 2 st generation	122.7	108.0
Genetic reserves, ha	2795.0	478.0

Nowadays while establishing forest seed objects, plus plantings and genetic habitats don't find common application, and are used only as objects of preservation of a valuable gene pool, and forest seed plantations are created on the basis of the selected plus trees allocated over the whole territory of Belarus. The plus trees allocated in various forest seed areas are introduced on one plantation. For example, on a plantation in Kobrinsky forestry station there is the posterity of the plus trees allocated in Orshansky, Disnensky, Gorodoksky forestries, though Kobrinsky forestry has its own plus trees.

For further development of the population direction in selection seed growing, the forefront task is to use best populations as seed objects, or to create on their basis forest seed plantations for population selection. At the same time in the best populations, which include plus plantings and genetic reserves, it's necessary to pick out not only plus trees, but also usual ones to be represented on the same forest seed plantation. Such plantations will reflect a gene pool of all population.

In total as on 01.01.2012 there are about 1,160,93 ha of first generation plantations and 596.8 ha of second generation plantations in the forestry establishments of Belarus, among them 903 ha and 474.6 ha are certified, accordingly. Scots pine plantations make 53.8% of total area of the plantations of Belarus. There are 399.2 ha of forest seed plantations certified in Polesky forest seed area; among them 261.2 ha are made by plantations of the 1st generation and 108 ha are

made by plantations of the 2nd generation. Pine plantations of Polesky forest seed area make 42.2% of total pine plantations area of Belarus. The share of seeds with the improved heredity makes 21.1% in Belarus as a whole. In Polesky forest seed area the share of pine seeds from clonal forest seed orchards makes 18.3%, and in Brest forest seed area – 37.4%, Gomel forest seed area – 10.0% (Table 2).

Table 2
The volume of forestry seeds procurement

Place of origin	Procurement volume, kg	
	total	pine
All the forestry of the Ministry of Forestry	67 515	6 999
Forest seed plantations	2 990	1 474
Polesky forest seed area	41 899	3 184
Polesky forest seed area together with forest seed plantation	1 401	585

The investigations of the state of forest seed plantations of the 2nd generation in Svetlogorsky forestry station show that plantations of 2003, 2004, 2005 years of creation have already entered into seeding stage, but their fertility is very weak and makes in average 0.2 kg per 1 ha (Table 3).

The main reason of low fertility is a low level of basic nutrients content in the soil. For example, the humus content is unsatisfying (0.45%), the phosphorus content is medium (8.8 mg P₂O₅ per 100 g of soil), for the potassium content see Table 3. A cone average mass and seed yield is larger on the plantations of 2003 and 2004 years of creation. On the plantation of 2005 year of creation the seeding stage has just begun, that's why cone yield is very low. The mass of a cone on the plantation averages 7.3 g, and seed yield is 0.7–1.0%. The main reason of low seed yield is a large number of closed cones which is the reason of large resin content caused by pests that damage cones. The second reason of low seed yield is weak male blossoming in the first years of seeding, and as a result a lack of pollen.

Table 3
Fertility of forest seed plantations in Svetlogorsky forestry station in 2013

Plantation establishment year	Yield score	Average cone yield per tree, pcs.	Quantity of seed trees per ha, pcs.	Cones gather per ha, pcs.	Mass of a cone, g	Seed yield, %	Seed quantity, kg/ha
2003	1	27	117	3159	7.44	1.0	0.24
2004	1	14	86	1204	8.09	0.9	0.09
2005	1	6	45	270	6.50	0.7	0.012

The range of cone size on the plantations is very wide: on the plantations of 2003 the length is 2.8–5.0 cm, the diameter is 1.8–2.4 cm. On the plantations of 2004 cones are larger; here cones length varies from 3.2 to 6.1 cm, and the diameter from 1.6 to 2.8 cm.

Cone mass is also larger on this plantation: it reaches 8.09 g. Clones that were brought into this plantation can be divided into three categories: large-coned (cone length is 5–6 cm, diameter is 2–3 cm), middle-coned (cone length is 4.0–4.9 cm, diameter is 1.5–1.9 cm), small-coned (cone length is 2.5–3.9 cm, diameter is less than 1.5 cm). For the division of clones by sizes see Table 4.

Table 4

The division of clones by size

The year of plantation creation	Clones with		
	large-sized cones, %	medium-sized cones, %	small-sized cones, %
2003	8.6	64.3	27.1
2004	23.2	53.6	23.2
2005	6.1	54.5	39.4

Currently in Belarus forest cultures are created on the area of more than 25,000 ha, including 21,500 ha of conifers (84.5%) annually. The share of the forest cultures created on the basis of improved seeds makes 31.9%. In Polesky forest seed area total amount of forest cultures is 9,044 ha, the share of cultures created on the basis of improved seeds makes 27.2%. The share of such cultures in Brest region makes 53.9%, in Gomel region it makes 18.9%. According to the Forestry Institute of the National Academy of Sciences of Belarus, the use of seeds with improved heredity allows to increase the productivity of artificial plantations by 15–20%.

According to the Strategic Forestry Development Plan of the Republic of Belarus till 2015, the share of forest cultures created by seeds from clonal forest seed orchards should make 50% of the total amount of forest cultures. For confirmation of this possibility, in Slutsky forestry station we conducted an examination of cultures that were created from seeds of clonal orchards of the first generation of the given forestry station (the trial areas 1 and 2) and from seeds of production yield (the trial area 3, the control area) (Table 5).

The choice of this forestry was determined by the clonal orchards of this forestry that were created on the basis of the plus trees allocated in plus plantings of the given forestry station which are the most adapted for these conditions and are distinguished by high fertility and hardiness.

Table 5

The parameters of the forest cultures grown from different breeding material

Age, years	Forest type and habitat type	Planting pattern, m	Original density, pcs./ha
6	P., A ₂	2.8×0.8	4460
5	P., A ₂	2.5×0.5	8000
4	P., A ₂	2.40×0.55	7575

The cultures created from the seeds taken from clonal orchards have better growth index in comparison with the control area.

An average height of a 5-year old tree reaches 1.4 m, root neck diameter reaches more than 2 cm. Livability of the given cultures is rather high and makes 88.4–90.1%. Average height increment of cultures that were created from selective planting material is 2 times higher than planting material from control area (Table 6).

Table 6

Growth indices and livability of forest cultures that were created from different planting material

Average parameters of plants, cm						Livability, %
trunk height	t-test	height increment	t-test	root neck diameter	t-test	
148.1 ± 4.2	18.1	25.2 ± 1.4	7.2	2.14 ± 0.1	4.0	88.4
137.3 ± 3.7	17.3	27.1 ± 1.7	7.3	2.08 ± 0.1	3.6	90.1
49.1 ± 3.5	–	12.3 ± 1.1	–	1.57 ± 0.1	–	88.4

According to the presented data, cultures that were grown in clonal seed orchards can be transplanted into forest area at the age of 5 years, while in compliance with normative documents transplantation to forest area has to be carried out at the age of 7 years.

Conclusion. The clonal orchards of Scots pine of Polesky forest seed area make 42.2% of all pine plantations in Belarus. The share of seeds harvested from clonal orchards in Polesky forest seed area makes 18.3%, which is less than average performance in Belarus. The fertility of Scots pine of the second generation in Svetlogorsky forestry station is extremely weak. The main reason of low fertility is lack of the main nutrients in the soil and damage of cones caused by pests. Forest cultures that were created from the improved selective material in Polesky forest seed area make 27.2%, while average share in Belarus makes 31.9%. The cultures that were created from selective improved material have advantage of the ones that were created from the seeds of production yield.

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Received 21.01.2013