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DEVELOPMENT OF NEW METHOD OF GROWING PLANTING MATERIAL WITH CLOSED ROOT SYSTEM

The results of studies of the effect on the growth of Scots pine planting material with closed root system of different periods of growing in the closed and open ground. Outlines the main features of technological operations carried out on the experimental facilities, including the quality of seeds, the kind used containers characteristic substrate dosage contributed main fertilizer, dolomite and agroperlite. Refer fertilizing system with deadlines of application, type of fertilizer and dosages for the active substance per unit area. Specify the duration growth of seedlings in the greenhouse, and on the polygon rearing. Investigated the height of the overground part and root collar thickness of the stem pine seedlings at the end of the growing season on the various options of growing. Based on the findings formulate conclusions and recommendations for growing seedlings particular purpose.

Offer the technology of growing seedlings with closed root system without elevated status, using capillary mats. This technological solution reduces the complexity of the work performed, to improve the quality and biometric parameters of planting material, as evidenced by the comparative characteristics of seedlings grown on trays and capillary mats.

Key words: seedling, greenhouse, capillary mat, container, biometric parameters.

Introduction. In recent years, the forestry industry seeks to carry out all forest management activities, including the area of reforestation using the experience of advanced Scandinavian forest countries. In Finland 80% of reforestation is currently carried out by silvicultural methods. It also required the use of industrial methods of cultivation of planting material based on the planting material with closed root system (PMCR).

The use of planting material with closed root system is one of the promising directions of artificial reforestation. It is associated with radical changes in agricultural technologies of the planting material growing and with considerable changes in the plantation technologies. In foreign countries, PMCR growing in test and production scale is tested from the late of 50th of the last century. It really became widespread in some countries. In the various countries of the world, significant areas of forest plantations are created with PMCR using. The share of these landings reach 86% of the area of the creation of new forests in Finland, Sweden – 67%, Canada – more than 50% (in the province of British Columbia – 76%), Norway – 48%, Poland – 20%, on the Pacific coast of the USA north-west – 20%, Russian – about 5%, Lithuania – 3% [1].

In the future, in many forest countries, number of artificial plantations with planting material having closed root system will be built up, and their performance in this area will approach the level achieved by countries with intensive forest management.

It is not the cheapest way of regeneration, but it allows you:

– to carry out the planting during the frost-free period;

– to minimize the effect of depression in the seedlings planting;

– to increase the survival rate and safety in the first years of cultivation;

– to reduce the number of agronomic and silvicultural care;

– to make lower the density of planting per per unit area up to 2,500 units/ha.

– to allow earlier and fuller use of the safe, environmental and ecological functions of the forest.

Unfortunately, the methods of cultivation of planting material with closed root system, despite their efficacy confirmed by numerous studies conducted in different ecological zones in Belarus, until recently, did not find wide practical application. However, there is every reason in the period when the use PMCR reforestation in Belarus can significantly be changed in the direction of increasing, both in areas of use and in number. The examples of this are the widely used practical industrial methods of timber growing (wood pulp) that are intensively developing in the world. The main one is the various purposes plantation forest growing. Naturally, all the processing steps from “seed to harvest” should get its development. PMCR is the main link in this process chain.

In our country, we plan to increase to 6% of the total annual area of forest planting and seeding the proportion of the plantation planting material with closed root system in 2016. Moreover, its number is planned to be subsequently increased to 17% by 2020.

Existing and applied production technology of mentioned planting material requires improvement and refinement. The development of specific production technologies is required to produce planting material with its given biometric indicators in connection with the different purposes.

Main part. In spring of 2014 some experimental species were planted in the Republican breeding and seed production center in order to study the effect of the growing of pine seedlings with closed root system in the greenhouse and on the range rearing on their biometrics.

For seeding the seeds of Scots pine of the 1-class quality with germination of 98% were used. Seeding was carried out in Plantek 64F tapes, having a small cell volume (115 cm^3), in which planting material is usually grown in one year.

Giving great importance to the substrate, we used peat moss milling work piece having water-air regime favorable to plant and being a good antiseptic. It contains a large number of phenolic compounds and organic compounds in the form of humic and fulvic acids, which act as plant growth stimulants. Acidity was 3.0–4.5 pH, decomposition degree was't less than 15–20%. This peat is highly moisture absorption, together with this there is no leaching of nutrients from the substrate at frequent watering. This peat moss is very poor in plant-available form of nitrogen, phosphorus, potassium and trace elements. For normal development of plants needed minerals such as iron, copper, molybdenum, zinc and boron [2].

The dolomite powder in a dose of from 4 to 12 kg per 1 m^3 of peat was used to neutralize the acidity. The soil complex mineral fertilizer with microelements PG mix produced in the Netherlands at the rate of 2 kg per 1 m^3 of nutrient substrate was applied to enrich the nutrient substrate nutrients. This fertilizer achieves uniform distribution of nutrients throughout the volume of the substrate and provides a high degree of water-soluble phosphorus uptake.

For optimum ratio of air and moisture held in the nutrient substrate agroperlit in a proportion of 0.17 m^3 per 1 m^3 of nutrient substrate was added.

In the greenhouse seed containers were placed on supports for cultivation with the use of “air pruning of roots” and the formation of a compact root system within the cell. PMCR growing in the greenhouse was carried out in three variants:

1) for 1.5 months;
2) within 3 months;
3) keeping the seedlings in the greenhouse until the end of the growing season. Then planting material was removed from the greenhouse to the field rearing.

Watering and fertilization on the system shown in Table 1 were carried out simultaneously in the process of growing.

After the end of the growing season, the plants were measured the height of the aerial part and the diameter of the root collar. Biometric indicators of planting material are presented in Table 2.

Table 1

Fertilizing system for Pinussylvestris seedlings with closed root system

Fertilizing timing	Fertilizers applied	Elements applied, g/m^2
After 10–15 days after the appearance of mass shoots	Crystalon Blue	$N_{19}P_6K_{20}$ + ME
After 15 days after the first one	Crystalon Yellow	$N_{13}P_{40}K_{13}$ + ME
After 15 days after the second one	Crystalon Special	$N_{18}P_{18}K_{18}$ + ME
After 15 days after the third one	Crystalon Special	$N_{18}P_{18}K_{18}$ + ME
After 10 days after the forth one	Crystalon Special	$N_{18}P_{18}K_{18}$ + ME
After 15 days after the fifth one	Crystalon Brown	$N_3P_{11}K_{38}$ + ME
After 15 days after the sixth one	Crystalon Brown	$N_3P_{11}K_{38}$ + ME

Table 2

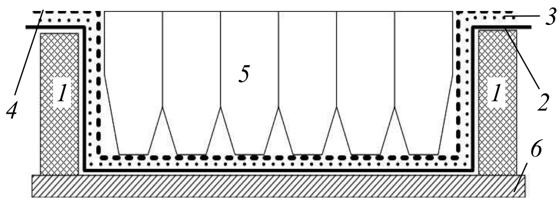
Biometric indicators of Pinussylvestris seedlings with closed root system

Experiment number	Mean height, cm	Mean diameter of root collar, mm
1	8.0 ± 0.2	1.98 ± 0.03
2	10.7 ± 0.3	1.84 ± 0.03
3	12.1 ± 0.3	1.94 ± 0.04

These results suggest that the largest growth rates in root collar diameter reach seedlings with the lowest period of stay indoors, but in this case they have the smallest increase in the aerial part. The seedlings left for growing in a greenhouse until the end of the growing season reach the greatest growth rates in height. They are slightly inferior to the first embodiment to the thickness of root collar. Planting material grown in a greenhouse during 3 months has the lowest growth rate of the diameter of the root of the neck, but the height of aboveground parts are close to the maximum values. It should be noted that whatever be the experiment all seedlings were lignified and formed terminal buds to the end of the growing season.

In GOLHU “Gluboksky experimental forestry” a study of cultivation technology PMCR using capillary mats was implemented. Growing seedlings in the greenhouse was carried out without the elevated status instead of the traditional technology with supports using. The ground is covered with agrotextile. A wooden box is set in it, a layer of plastic film is put in, and it is fit with a special material called capillary mat (Figure).

The special structure of capillary mat material allows to accumulate excess water and deliver it to the cell to the root systems of plants between waterings. In this case, the root systems are formed within the cell and does not go beyond the limits of the container. It is very important for quality of planting material. This technology solution allows growing planting material to reduce significantly labor costs and in general to achieve a significant economic benefit without using stands.



Scheme of the cassette on capillary mats:
1 – wooden box; *2* – agrotextile;
3 – plastic film; *4* – capillary mat;
5 – cassette; *6* – soil

The seedlings were fertilized 4 times during the growing season.

The efficiency of applied technological decisions is proved by the comparative biometric indicators of planting material (Table 3). It was grown by using:

1) stands;
2) capillary mats.

Biometric indicators of seedlings, grown in the experiment #2, are 28.1% higher than those of the first embodiment and are 28.5% bigger according to the diameter of the root collar. It can be argued that the use of this technology is promising for widespread industrial introduction.

Table 3

Biometric indicators of spruce seedlings with closed root system

Experiment number	Mean height, cm	Mean diameter of root collar, mm
1	14.6 ± 0.7	1.86 ± 0.73
2	18.7 ± 1.1	2.39 ± 0.14

Conclusion. Adjusting the timing of PMCR cultivation in the open and closed ground allows growing the plants depending on their purpose and the required biometric data. Reducing the period of cultivation PMCR on closed ground allows you to sow a few rotations, and to increase the amount of planting material produced. Therefore, for the successful functioning of the technological complex, you need to take into account biological, environmental as well as economic factors.

An effective alternative to traditional PMCR cultivation in stands (elevated condition) is the use of capillary mats. This technological solution can reduce material and labor-consuming cultivation of planting material with closed root system, and, consequently, its cost, while improving the quality and biometric characteristics of seedlings.

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