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GROWTH SPECIFICS AND PRODUCTIVITY OF HOME AND INTRODUCED ARTIFICIAL TREE SPECIES PLANTATIONS

The results of the analysis of growth rates and production of artificial plantations of local and introduced tree species are presented. Brief information about the forests introduction in Belarus in the historical aspect is reported. Characteristics of research facilities located on the territory of the Republican biological reserve “Pryluky” are given. All properties are in close proximity to each other in identical conditions of habitat (type of forest growth conditions D₂ Kislichnaya series of forest types, soil, sod-pale-podzolic loamy medium podzolennaya, a powerful loess). The studied plantations ranged 70 to 106 years, which allows you to make objective conclusions about the success of their growth and formation.

Analysis of plantation growth rates shows that high productivity is characterized by 106 years old plantation of European larch and 80 years old culture of Douglas Fir (stem wood stock is respectively 695 and 740 m³/ha). Norway spruce plantations (reserve in 71, returned more than 690 m³/ha) from the local coniferous-forest-forming species demonstrate high growth rates that are not inferior to exotic species. Stocks of stem wood and the average increase in pine plantations are significantly lower (at the age of 87 respectively, 505 m³/ha and 6.0 m³/ha per year). Pure and mixed stands of oak Northern demonstrated higher rates of growth and production compared to *Quercus robur* tree stands.

Key words: forest cultures, local and introduced species, indicators of growth and production, supply of stem wood, the average increase.

Introduction. One of the promising ways of forest productivity increasing, improving their quality composition and landscape and aesthetics characteristics, enhancing of water and soil protection functions is creation and cultivation of artificial plantations of introduced tree species. According to many scientists, in optimal conditions of habitat, exotic species can form phytoce-notic resistant plantings, which outproduce the stands from local forest forming species. However, the problem of the rational introduction of introduced tree species in forest plantations remains highly controversial, because of, above all, a small area of these plantations on the territory of Belarus and the lack of sufficient information about the features of their formation for a long time.

Experimental works on the cultivation of plantations of exotic tree species on the territory of Belarus have started in the late XIX century. The first tree species introduced into the forest culture in 1,830, was the European larch [1]. In pre-revolutionary period, the works on introduction of tree species in forest plantations were of episodic and mostly amateur character. In the pre-war period, these works were more active and about 20 exotic plants with dominated Siberian and Far Eastern species were introduced in the forest. After the war and up to the 60-s of XX century there was an active testing work on a wide range of exotic species in forest plantations on relatively large areas. Totally, during this period 41 species of exotic plants were introduced in forest plantations. By the early 70-s, in the forests of the Republic introduction works ceased, and after 10 years, the area

occupied by exotic species plantations, sharply decreased. The main cause of death was lack of proper care of exotic plants, as well as the imbalance of habitat conditions and biological characteristics of species [2].

Main part. The studies were carried out on stationary experimental plots in local and introduced tree species plantations of artificial origin, laid by the staff of the silviculture department under the direction of Professor Y. D. Sirotkin in 1970–1980. Stations are located in the close proximity to each other under identical conditions in the habitat of oxalis series of forest types (D₂). The soil is sod-pale-podzolic, moderately podzolic loam, on a powerful loess. Under these conditions, highly productive plantations growing on the I and I^a value class were formed. Geographically, studied objects are located in the Republican Biological Reserve “Pryluky”, formed in 2007. The reserve was created in order to preserve the important forest areas in natural state and their growth locations, including plantations of exotic species.

Artificial exotic plantations of species such as European larch, Douglas Fir, Weymouth pine, Murray pine, northern oak, etc. grow on the area of the reserve. Also, there are forest plants of forest forming species such as Scots pine, Norway spruce, English oak, and others. The investigated plantations are between 70 to 106 years, so at present their formation it is possible to make valid conclusions about the success of their growth and production.

The growth rates analysis of local and introduced species plantations shows that under these forest growing conditions, all plantations grow by

I^a and I quality class. European larch plants with very open planting density (4.3×1.4 m, 1,600 pcs./ha) are highly productive phytocenotically resistant plantations. It should be noted, that when there is a small number of trees (315 pcs./ha), the stem wood supplies are high and constitute 695 m³/ha, and the volume of one trunk is an average of 2.2 m³. All trees are characterized by a high quality of trunk and good cleanability of branches. Forest pathology survey results showed a high biological resistance of larch to fungal diseases and pests damages. Only individual trees (not more than 2% of the total) have small in size crowns cancerous cells.

The North American exotic tree Dicouglas Fir is characterized by an intensive growth in forest plantations. Planting scheme is 1.5×1.0 m (density is 6,670 pcs./ha). Currently hemlock forest plantations have preservation of 7.5% (430 pcs./ha), and the stem wood supply is 740 m³/ha, at an average growth rate of 9.3 m³/ha per year. However, one should note along with these high rates the growth weakening and forest pathology state deteriorating of hemlocks for two past decades. Probably, these phenomena were caused by summer droughts that periodically occurred in the territory of the republic, since 1992. One of the biological characteristics of hemlock is the formation of a powerful root system surface, which makes it vulnerable at ripening age under extreme weather conditions.

Harmful impact of pine fungus and stem pests significantly increased in the weakened plants. Currently weakened and drying trees made more than 13% of the supply.

Coniferous plantations of local species are characterized by high growth rates in these forest conditions. Forest plantations of Scots pine at the age of 87 years are grown on the I^a value class and have a stem wood supply of 505 m³/ha. Common species of spruce created at a density of 6,670 pcs./ha located on 1×1 m, at the age of 71 have the preservation of 9.4%, stem wood supply is 694 m³/ha. Thus, the artificial plantations of spruce are much more productive in comparison with European pine stands in the rich environment. This is due to the high preservation of the spruce trees, while, an increasing tree mortality in pine plantations at the ripening age is observed, according to noted research results of many scientists.

It should be noted that the pine plantations of more than 10% of the stem wood supply are presented by dead and dry out trees. The main reasons of weakening and dying out of trees are their injury by blistered cancer and root rot caused by pine fungus and honey mushroom. In the investigated spruce stands, ulcerative cancer injury of tree trunks was revealed. Cancers hit 12.6%, and the number of dying and dead is 6.6% of the total number of trees [3].

Silvicultural and taxation features of plantations

Testplot area number	Range	Composition		Age, years	Average height, m	Average diameter, cm	Cross sections amount, m ² /ha	Value class	Number of trees, pcs./ha	Stem wood supply, m ³ /ha	Average growth increase, m ³ /ha per year
1	I	L	100	106	34.7	44.2	48.4	I ^a	315	695	6.6
	II	Sp	56	81	22.4	28.8	7.8		120	84	1.0
	II	O	44	66	21.7	25.0	6.3		128	65	1.0
							62.5		563	844	8.6
2	I	F	95	84	28.6	40.5	55.4	I ^a	430	740	8.8
	I	L	5		21.2	26.7	3.9		70	38	0.5
							59.3		500	778	9.3
3	I	P	100	87	31.8	37.8	38.1	I ^a	339	505	6.0
	II	Sp	100	39	13.1	16.0	10.7		525	77	2.0
							48.8		864	582	8.0
4	I	Sp	100	71	29.8	31.9	50.1	I ^a	626	694	9.7
5	I	O. n.	100	78	30.3	40.5	49.2	I ^a	380	689	8.8
6	I	O. n.	100	78	30.1	39.4	50.3	I ^a	413	695	8.9
	II	M	100		12.8	11.8	1.4		127	9	0.1
							51.7		540	704	9.0
7	I	O	100	71	25.3	31.7	33.2	I	419	386	5.4

Forest cultures of northern oak pure by composition were created with an initial density of 3,330 pcs./ha with a planting scheme 3×1 m. Planting grows on the I^a value class and at the age of 78 years is characterized by a high supply of stem wood (689 m³/ha) and the average growth increase (8.8 m³/ha per year), preserving is 11.5%. At the same time in northern oak forest plantations mixed with the Norway maple and European ash (row mixing, planting scheme is 1×1 m, the initial density is 10 thousand pcs./ha) northern oak has a somewhat greater preservation, but growth and production rates significantly do not differ from pure plantations. It should be noted, that in the process of mixed cultures formation in the result of antagonistic relationship European ash fully dropped from a mixture and Norway maple is preserved as a single sample of the second range.

Taxation rates analysis of English oak stand (no. 7) shows that they are much lower than those of red oak. English oak forest cultures were created with density of 6,670 pcs./ha with a planting scheme 1.5×1.0 m. The cultures preservation at the time of study was 6.3%. Forest pathology inspection of oak

plantations showed that red oak is largely (20%) injured by graduated cancer. In the locations of cancerous ulcers a new growth is seen significantly changing the shape of the trunk. In the English oak plantation infectious diseases, such as vascular mycosis of branches, necrotic diseases, root rot (approximately 25% of the trees are infected by honey mushroom) are found out. As a result of combined disease development a part of severely weakened trees moved in the category of dead wood.

Conclusion. Growth success analysis of local and introduced tree species plantations shows that under the rich forest conditions (D₂), characterized by loamy soils, highly productive plantations are formed. The long period of observation allows to make the conclusion that from coniferous species the most perspective in terms of productivity and biological stability is the European larch. High rates of growth and reproduction characterize Douglas fir and spruce stands, but they are less resistant to unfavorable environment factors. Northern oak plants have significantly higher rates of growth and productivity in comparison with the English oak.

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