ORIGINAL ARTICLE

The state of monocultures in the territory of green zones of vladivostok agglomeration (the program "Big Vladivostok")

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Abstract

Aim: The article presents the taxation data and the description of artificially created cultures, such as Manchurian walnut, Manchurian ash, Amur cork tree, Maximovich poplar, Korean pine, and common pine. The analysis of growth of these wood species was made. The existing cultures of woody species were created in the late 1960s and early 1980s. **Materials and Methods:** A total of 40 sampling areas within the boundaries of green zones of "Big Vladivostok" cities were laid down for the analysis of the growth of different woody species. **Results:** No young growth found from plantations of forest culture in close proximity to the cities. Primarily, in the first class of the planting age, they have the III Class of growth. With further growth, the bonitet rises to I and the II Class. **Conclusion:** The analysis of the growth of the studied woody species, growing in different geobiological conditions, testifies to the high energy of their growth, by every taxation measure; therefore, given species can be recommended for the creation of environmentally sustainable green belt.

Key words: Amur cork tree, green area, invasive plant, Korean pine, common pine, Manchurian ash, Manchurian walnut, Maximovich poplar, monocultures

INTRODUCTION

The forest cover of the Far East is very high. From 3% to 16% of the area, timber resources, biological diversity of this form of vegetation cover, is collected in the forests of the Russia's Far East (RFE). There are 144 species of trees, 224 species of shrubs, 26 species of woody vines, 57 species of subshrubs, 23 species of dwarf semishrubs, and more than 2700 species of herbs on the territory of the Far East. Walnuts - 14 species, berries - 121 species, vegetables - 200 species, juices - 28 species, melliferous - 250 species, essential oil - 144 species, officinal - more than 1,000 species.[1,2]

Here are about 20 billion cubic meters of timber; the forests occupy about 274 million hectares, amounting to 29% of forest resources and 46% of the overall forest land of Russia.[3] However, over the past 20 years, the infrastructure of protection and restoration of forests has been losing, and that has an impact on recourses of mature wood, especially valuable species, and leads to a partial loss of such important non-woody forest resources as wild berries, vegetables, mushrooms, furs, and honey, and as a result, the sustainable development of forest excessive areas becomes impossible. In the Far East, according to Urusov, 70% of wood material is the result of continuous felling, 20% is the result of selective felling, and the structure and composition of forests in the region require a predominance

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Received: 04-07-2017
Revised: 29-07-2017
Accepted: 14-08-2017

of selective felling; they should provide 40-45% of the wood material, at 30-40% of wood material from continuous felling, and 10-30% - from the gradual felling.[4]

From the beginning of the 1950s, such monocultures as Manchurian walnut, Manchurian ash, Amur cork tree, Maximovich poplar, Korean pine, and common pine were created to restore and diversify the forest fund of the Primorsky Krai, to determine the availability of different wood materials in short terms and the possibility of moving to the massive planting of cultures in the territory of the State Forest Fund.[5] Since 1950-70s, within the territory of the forest districts of Primorsky Krai, common pine has been the main introduced wood specie, which has been massively planted in the late 1960s - early 1970s. The state of this wood specie is unsatisfactory as a whole in the territory of the Vladivostok forest districts, as well as within the Primorsky Krai. Hence, in the 1970s, the scientific community decided not to create forest cultures of non-recognized species. In general, planting was made in the border area, for the creation of firebreaks, to prevent the moving of cross-border fires across the state border of the Russian Federation.

Using cultures, people create forest plantations of fast-growing and introduced woody species, plantations, as well as they ennoble recreational forests, reconstruct subsidiary crops, recultivate damaged lands, and so forth. Thus, the silvicultural work is a set of interrelated activities, aimed at creation of valuable forest plantations for different target destinations.

MATERIALS AND METHODS

A total of 40 sampling areas within the boundaries of green zones of "Big Vladivostok" cities were laid down for the analysis of the growth of different woody species.

Brief taxation characteristics of the main forest-forming species are given below.

RESULTS AND DISCUSSION

Manchurian walnuts are the monocultures, created in Ussuriysk urban district in the 1950-60s, and their total area is 21 hectares [Table 1].[6]

It should be noted very beautiful appearance of the tree, valuable fruit (nuts), valuable wood materials, and medicinal properties. No wonder, for example, the Far East scholar, honored Russian forester N. V. Usenko wrote about Manchurian walnut in his book "Gifts of the Ussuri taiga:" "There are many beautiful trees in the Ussuri taiga. However, look at the Walnut, when it is surrounded by velvet, ash, oak, and other trees, you will agree that it is the best. It should be planted more in gardens, parks, boulevards, alleys, and in group plantings."

Manchurian ashes are the monocultures, created in the territory of the Ussuriysk and Artemovsk urban districts in the 1970s, and their total area is 26 hectares [Table 2].

Ash forests have great environment oriented value, water protection, water regulation, bank and slope protection value, and in some places, they protect breeding areas.

The bark, buds, leaves, and flowers of ash are used in a number of European countries as drug raw materials [Figure 1].

Maximovich poplars are the monocultures, created in Ussuriysk urban district in the 1970s, aimed to reduce the terms of growing of low-value wood material (for cellulose and paper production) and increasing the productivity of plantations, and their total area is 19 hectares [Table 3].

Amur cork trees are the cultures, created in the territory of the Vladivostok forest district (Ussuriysk urban district) in the 1960s, and their total area is 8 hectares [Table 4]. Historically, the cultures of cork tree (in the Primorsky Territory) had been creating from 1948 to 1969. For a long time, the bark of the cork tree, more precisely, its cortical layer was considered the main value of the tree. Cork bark was collected, crushed, and made expanded cork - lightweight extruded plates. They did not sink in water and had excellent thermal, acoustic, and electrical insulating properties. During the "cold war" with the United States (1950-1960s), Americans have developed a program for building aircraft carriers, capable to inflict bomb, and missile attacks almost on the whole territory of our country. In response, the Soviet Union decided to build conventional and atomic-powered submarines, where expanded cork was used as insulating material. In this regard, the volume of plantings with Amur cork tree sharply increased within the forest districts of the Far East Region.

Table 1: Taxation characteristics of sampling areas, planted with Manchurian Walnut

Composition	Growth class	Age	Diameter, cm	Height, m	Density	Volume, m³/ha
2	3	4	5	6	7	8
10 Walnuts	III	37	20.0	11.3	0.6	72
10 Walnuts	II	59	24,1	18.1	0.8	172
10 Walnuts	I	37	16.3	16.2	0.4	62
10 Walnuts	I	40	16.8	17	0.5	75
10 Walnuts	I	40	16.8	16.2	0.5	75
6 Walnuts, 4 Maples	I	37	16.6	16.5	0.5	75

Table 2: Taxation characteristics of sampling areas, within artificially created plantings of Manchurian ash

Composition	Growth class	Age	Diameter, cm	Height, m	Density	Volume, m³/ha
2	3	4	5	6	7	8
10 Ashes	I	50	24.5	18	0.4	76
10 Ashes	II	45	31.5	17	0.4	62
10 Ashes	I	39	31.5	16	0.4	62
10 Ashes	I	30	22.4	12	0.3	34.5
8 Ashes 2 Oaks	III	55	20.4	13	0.4	68
10 Ashes	III	45	18.6	12	0.3	43.5

Table 3: Taxation characteristics of sampling areas, within artificially created plantings of Maximovich poplar

Composition	Growth class	Age	Diameter, cm	Height, m	Density	Volume, m³/ha
2	3	4	5	6	7	8
10 M. Poplars	I	50	29.4	19.3	0.5	130
10 M. Poplars	I	53	28.0	20.0	0.4	104
10 M. Poplars	I	50	27.2	19.2	0.5	130
10 M. Poplars	II	45	24.3	14.3	0.5	107.5
10 M. Poplars	I	50	24.8	19.5	0.7	182

Table 4: Taxation characteristics of sampling areas, within artificially created plantings of Amur cork tree

Composition	Growth class	Age	Diameter, cm	Height, m	Density	Volume, m³/ha
2	3	4	5	6	7	8
10 Amur cork trees	III	40	14,5	9,5	0,6	30
10 Amur cork trees	IV	45	15,2	9,6	0,5	20
10 Amur cork trees	IV	45	16,5	9,2	0,6	24
10 Amur cork trees	III	50	9,4	12,5	0,6	42
8 Amur cork trees, 2 Oaks	IV	44	18,1	8,5	0,5	20
10 Amur cork trees	IV	50	18,6	10,1	0,6	36

Figure 1: Maximovich poplar

Farms specializing in the cultivation of Amur cork tree were created; funds for scientific researches were allocated; monographs and numerous articles about this rare and relict specie were published. During this time, 8302 hectares were allocated for planting.[7]

Over time, the demand for the bark began to decline industry, including the military, began to use other, more affordable insulation materials. The creation of cork tree cultures was stopped, and it was less used. The felling of Amur cork tree is prohibited although the need for its wood is very high. Light, resistant to rotting, beautiful in color and structure, it is suitable for the production of furniture and decoration materials in the form of peeled and sliced veneer. The control for the state of Amur cork tree is absent from the side of forest district workers. The reason for this, in a large extent, is the replacement of cork by artificial materials.[8]

On the basis of the researches, carried out on the territory of "Big Vladivostok," we can make the following conclusion: The basic mass of the Amur cork tree cultures is in poor condition [Figure 2].

At the present time, it is necessary to tend the forest cultures, at least with the purpose of saving their biological diversity.

Korean pines are the cultures, created in the territory of the Ussuriysk urban district in 1980s-90s, their total area is 43 hectares [Table 5].

From 1959 to 2001, the areas of forests with Korean pine decreased by 33.6% in the Primorsky Territory. Over the past 100 years, the area of Korean pine became fragmented, and its population structure was broken. The part of the gene resource, in the form of highly-productive plantations of pine, was irretrievably lost because this specie for a long time was the main object of logging. The Primorsky Krai has 3 forest seed districts, so within its territory, it should be allocated not <9 genetic reserves, but now in Primorye, there is none [Figure 3].[9]

Common pine is the first coniferous invasive plant in Primorye. At the end of XIX, early XX century, Nikolskiy forest district has Priamurskaya lower forest school, preparing the students for the lower forest positions, such as keepers, lap men, and forest guards. The school made it into the history, for the planting of pine forest area of 1.7 hectares, by the pupils of this school under the guidance of a forester N.S. Bogolyubov in 1900, in the village Kamenushka (formerly tract Piyankov Zavod).[10] According to Kolesnikov (1946), Urusov and Varchenko (2010), in Barsukovskaya Grove (since these cultures came to be called), the planting places were located at the corners of squares with a side of 1 fathom. Primarily, there were 75 rows from the north to the south and 50 rows from the east to the west. 3750 seedlings (2200 pieces per 1 ha) were placed on the whole area of 1.7 hectares. In the 60s of the twentieth century, this area became a part of the Training and Experimental Forestry of Primorsky Agricultural Institute, where students of the Forestry Faculty annually carried out practical trainings in different disciplines such as forestry, taxation, forest cultures, plant pathology, and others [Figure 4].

There was a summer camp, near the pinery, and the forest was constantly filled with people. The growth of pine is characterized by the I Class of growth, with the accumulation of more than 500m³ of total wood volume, (V.M. Urusov indicates 660 m³/ha), at that, every fourth tree had different defects, i.e., the technical defectiveness reached 25%. At the age of 60-80 years (the IVth age class, for the pine, it is a middle-aged planting), almost all of its trees were damaged by a variety of wood decaying fungi, many of pine trees were sick and were completely dried. The existing cultures of this specie were created in the late 1970s and early 1980s, and their total area was 21.9 hectares [Table 6].

The analysis of the state of artificially created plantings of Manchurian walnut, Manchurian ash, Amur cork tree, Maximovich poplar, Korean pine, and common pine, planted from 1954 to 1980, indicates about their low capacity for survival, which after 25-40 years reduces to 14-25%, depending on the location of the researched object. This fact confirms the need for the expansion and reconstruction of green areas of "Big Vladivostok" cities. The main reasons for the decline of plantings capacity for survival are forest fires and unauthorized felling. Phyto- and entomological situation, the general condition, and growth are satisfactory.

Figure 2: Amur cork tree (the bark)

Figure 3: Monoculture of the common pine (village Kamenushka)

Figure 4: Monoculture of the common pine (village Duboviy Klyuch)

Table 5: Taxation characteristics of sampling areas, with plantings of Korean pine

Composition	Growth class	Age	Diameter, cm	Height, m	Density	Volume, m³/ha
2	3	4	5	6	7	9
10 Korean pines	II	20	8.0	4.0	0.3	2.1
10 Korean pines	II	30	10.0	5.0	0.3	
10 Korean pines	III	37	10.0	6.3	0.4	
10 Korean pines	III	40	12.0	6.3	0.4	
10 Korean pines	II	21	8.0	4.2	0.3	

Table 6: Taxation characteristics of sampling areas, within artificially created plantings of common pine

Composition	Growth class	Age	Diameter, cm	Height, m	Density	Capacity for survival, %	Volume, m³/ha
2	3	4	5	6	7	8	9
10 common pines	1	37	24.9	16.0	0.6	8.2	72
10 common pines	3	26	18.8	8.6	0.5	36.4	-
5 common pines, 5 ashes	1	29	21.1	12.2	0.6	38.3	-
10 common pines	1	36	22	15.0	0.6	22.6	72
8 common pines, 2 oaks	2	33	22.5	10.5	0.5	24.1	-
10 common pines	3	30	22.0	8.0	0.6	29.7	-

CONCLUSION

It should be noted that in the plantations of forest cultures, located in the close proximity from the cities (3-5 km), there is practically no young growth. Primarily, in the first class of the planting age, they have the III class of growth. With further growth, the bonitet rises to the I and the II Class. The analysis of the growth of the studied woody species, growing in different geobiological conditions, testifies to the high energy of their growth, by every taxation measure; therefore, given species can be recommended for the creation of environmentally sustainable green belt.

REFERENCES

1. Kharkevich SS, editor. Vascular Plants of the Soviet Far East Vol. 1-8. Saint Petersburg: Nauka; 1985-1996.
2. Tagiltsev YG. In: Tagiltsev YG, Kolesnikova RD, Nechaev AA, editors. Far Eastern Plants are Our Doctor. Russia: Khabarovsk; 2004. p. 520.
3. Far Eastern Forestry Research Institute. The Analysis of the Statistical Reference Data. Russian Federation, Khabarovsk city: Far Eastern Forestry Research Institute; 2015.
4. Urusov VM, Varchenko LI, editors. The Forests of the Russian Far East in the New Economic Situation. Vol. 10. Vladivostok: Bulletin of the Krasnoyarsk State Agrarian University; 2010.
5. Gukov GV, Rozlomiy NG, editors. Recreational Potential Assessment of the Green Zone of Ussuriysk (Southern Primorye). Vol. 44. Ussuriisk: Journal of Research and Practice, Vestnik of Irkutsk State Agrarian Academy; 2011. p. 38-46.
6. Gukov GV, Rozlomiy NG, Rafe OY. The Cultures of *Manchurian Walnut* in the Primorsky Territory// Proceedings of the All-Russian Scientific-Practical Conference the Forest, the Forest Sector and the Environment, Kazan; 2012.
7. Petropavlovskiy BS. In: Kovalev AP, editor. The Forests of the Primorsky Territory: The Diversity of Forest Types and Dendroflora//The State of Forests and Actual Problems of Forest Control: Proceedings of the All-Russian Conference with the International Participation/ Executive. Khabarovsk: Publishing House of Far Eastern Forestry Research Institute; 2013. p. 64-7.
8. Gukov GV, Rozlomiy NG. Relict Woody Plants of Primorsky Krai and their Decorative Properties. Vol. 10. Germany: European Applied Sciences; 2014.
9. Orekhova TP. The problem of the protection of Korean pine gene recourses (PINUS KORAIENSIS SIEB. ET ZUCC.) In: The Primorsky Krai and Ways of Its Solution//Coniferous of Boreal Zone. Issued by Siberian State Technological University. Vol. 3; 2012.
10. Kolesnikov BP, editor. To the systematics and the history of development of the larches from the section Pauciseriales Patschke. In: Material for the History of Flora and Vegetation of the USSR. Vol. 2. Moscow: Publishing House of the USSR Academy of Sciences; 1946. p. 321-64.

Source of Support: Nil. **Conflict of Interest:** None declared.