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Overall Results Of Heart-Rot Resistant As Pen Cultivation In Valentinovsky Tree Nursery (Moscow Region, Russia).

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ABSTRACT

Aspentrees (*Populustremula*) from experimental plantation created by academician A. Yablokovin Valentinovsky tree nursery at Schelkovsky scientific-experimental forest enterprise (Moscow region) were studied. Methods of dendrochronological analysis to identify resistant aspen forms are suggested. Growth parameters as well as heart-rot (*Phellinustremulae*) damage are studied, factors influencing aspen resistance are analyzed.
Keywords: Aspen, productivity, heart rot, dendrochronological analysis.

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INTRODUCTION

Aspen (*Populustremula*) is one of the most widely-spread species which is well-adapted to various ecological conditions and is fast-growing. Resistant forms of aspen can grow until 120 years and more. Aspen grows on the vast territory in Russia, from forest tundra to steppe, can be met in the Crimea and the Caucasus. However, out breaks of infections and intensive cuttings of highly productive resistant forms in XIX-XX centuries led to loss of biodiversity of this species. There are not many selection-valuable aspen forests left [7]. Natural selection of resistant forms, artificial selection of highly productive and resistant forms and hybrids of aspen, their preservation and reproduction is an important scientific task [8,9].

Valentinovsky tree nursery at Schelkovsky scientific-experimental forest enterprise was founded in 1946 by famous scientists and professors A. Yablokov, I. Melekhov, A. Lubavskaya and many others. This tree nursery is one of the training and production facilities of former Moscow State Forest University (now Mytischy Branch of Bauman Moscow State Technical University). Under prof. A. Yablokov's guidance the first complex researches were conducted on the following topic: "Detection, selection of fast-growing and rot-resistant aspen forms and agricultural technologies development of tending and cultivation of sound highly productive aspen on forest enterprises in Vologda region". His apprentice B. Vladimirov [3] continued searching for perspective clones and items of aspen for its propagation. The topic of his research is «Study of aspen forests in Monzensky and Vozhegodsky forest enterprises in Vologda region". 6309 ha of aspen forests were studied by B. Vladimirov. The prevailing types of forests in aspen stands are myrtillus forests, cowberry shrubs, mountain sorrels and forests with grass layer. Aspen stands on the territory of Monzensky forest enterprise initially were creeping-rooted. B. Vladimirov stated that in aspen stands of I, II, III, IV ageclasses and trees of medium and high productivity the cases of heart rot were very rare. Until the age of 36-38 there were single trees with heart rot in clones. Up to the age of 50 the infection of all clones was 14-18 %. Large-scale heart rot infection in natural aspen stands starts at the V age class. B. Vladimirov's and A. Yablokov's research in Vologda region aspen stands, growing in severe climatic conditions, showed that it is economically efficient to get sound merchantable timber in natural forests. Based on this research, a sample plot was set in 1962 by creeping roots from mother aspen stumps without rot.

Aim of the research. Studding aspen trees productivity in experimental plantings in Valentinovsky tree nursery. Detecting trees resistant to heart rot and other extreme ecological factors. Working out methods of resistant form selection by means of dendrochronological analysis.

MATERIALS AND METHODS

In this study we will deal with plantings from the model tree No 30 at the age of 78 years (at the time of year 1962) with the stump diameter of 64 cm. (extract from B. Vladimirov's field diaries of 1962). Mother aspen trees stand No 1 was growing in the quadrant 111 of Ozerskoe forest enterprise on the territory of 50 ha, density: 0.9, site index I, growing stock is 410 m3/ha, forest type aspen – myrtillus forest. The studied clone No 30 was established in 1962 by planting of 75 root shoots on the three rows of archive plot, out of which only 47 have survived by 2009.

Visual assessment of aspen trees viability showed that there are 10 trees of 5thcategory (dead wood of current year); 5 trees of 3rd category (very weak), 4 trees of 2nd category (weak) and 28 trees of the 1st category (without any trace of weakness). Breast height diameter of aspen trees from 1st category of viability is from 17.0 to 31.9 cm. Height is 20.3 m. While establishing sample plots we chose a model tree to compare taxation characteristics of experimental trees with table data of growth at the given forest growing conditions. The model tree did not have any heart rot along the whole length of the tree. Growth analysis of the model tree showed that its height at the age of 10 was 6 m, and the breast height diameter (without bark) was 6.3 cm. Tree height at the age of 20, 30 and 40 was correspondingly 10 m, 15.1 m, and 18.5 m and has reached 20.3 m at the age of 47. Diameter at 1.3 m at the age of 20, 30 and 40 was correspondingly 11.7 cm; 16.7 cm and 21.6cm, and at the age of 47 has reached 22.8 cm (table1). The comparison of taxation characteristics of the model aspen tree with the table data for aspen of the site index I has shown that its growth rate does not differ from the growth of normal aspen stand, and according to the diameter it is ahead of the table data at the age of 20 to 40 by 21.2 – 22.6 %.

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Table 1: Comparative evaluation of taxation characteristics for a model tree from archive planting with the table data of aspen growth rates

Age, years	Diameter, cm		Height, m	
	Table data for growth rates	Model tree	Table data for growth rates	Model tree
10	5,6	6,4	6,4	6,0
20	9,3	11,8	10,8	10,0
30	13,0	16,8	14,9	15,1
40	16,8	21,6	18,5	18,5

In August 2016 we were researching this plot. Every aspen tree was core-drilled. From some trees, we took 2 test cores at mutually perpendicular radii. Core drilling was at the height of 1.3 m with the help of Pressler increment borer. The tree rings was measured by using Lintab with accuracy 0.01 mm and after that cross dated by using computer program TSAP Win. For every recorded tree, we identified geographical coordinates, height, diameter, category, diseases or pests marks. The majority of trees was damaged by poplar leaf-mining moth, fruit bodies of polypore were not found.

Statistical manipulation

Trees are keepers of various long-term data, which is accumulated in dendrochronological information [1, 5, 6, 2, 4]. Information contained in dendrological rows can be used as data about environmental dynamics and biogeocenotical processes, viability and sustainability of trees.

The first step of initial data processing is to single out a function of age trend, all the coming results depending totally on the right choice of it. Radial increment index is calculated by this formula

$$It=Wt/Yt,$$ where

*W*t is the annual ring width per year *t*,
*Yt*is average annual ring width for 5 years for the year *t*.

Correlation analysis was mainly about measuring the degree of contingency between variable characteristics as well as about defining the form and directing the existing relations between them.

ANALYSIS AND DISCUSSION

During all its life tree genotype is the same. However, annual ring width varies dramatically year by year. Climatic factors contribute to a great deal to the variability of annual rings width according to years. The results of primary measurements – time series of radial increment – are shown on the fig. 1.

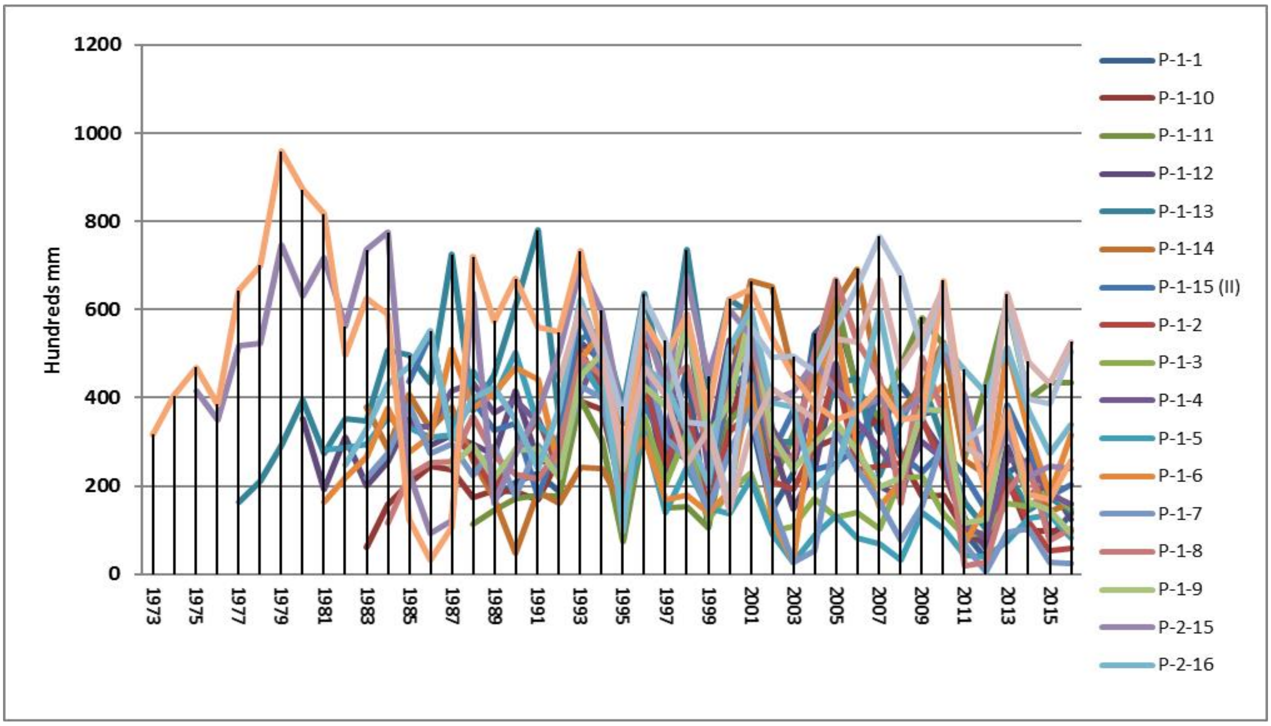

Fig 1: Dynamics of annual ring width of recorded trees by years

As you can see on the fig. 1, recorded trees differ by the annual ring width. Moreover, in some years narrow annual rings are formed, and in other years wide annual rings are formed. Analyzing this data, it is possible to identify favaurable conditions for high increment formation as well as unfovourable condition for it. While comparing the dynamics of radial increment lines between each other it is important to notice that in general it is quite synchronous, i.e. periods of increasing and decreasing increment are identical for different trees. Theyear 1995 stands out, because we can observe abrupt decrease of increment. The weather conditions of that year according to average annual characteristics could be analysed by climagram method. The results of comparison between average monthly temperatures by months in 1995 and normal annual characteristics of average monthly temperatures for the peiod of 1949-2015 are given on the fig. 2.

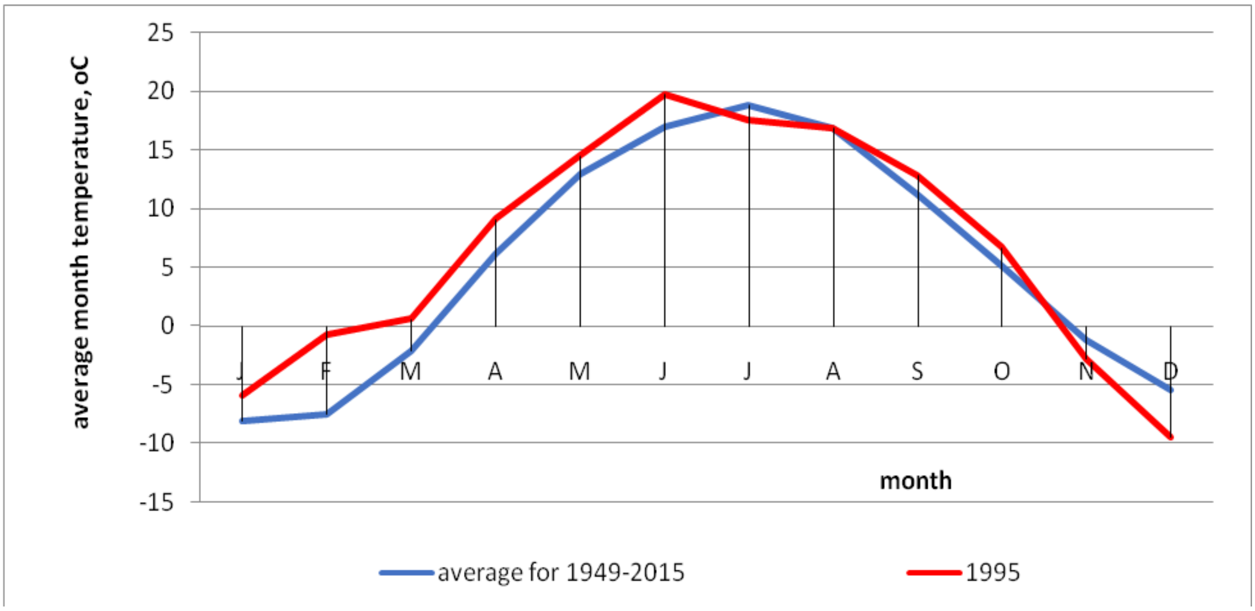

Fig 2: Results of comparison of average month temperatures for 1995 year with the average temperatures for 1949 – 2015 period.

Fig.2 clearly shows that the weather situation in 1995 was characterized by elevated air temperatures in January, February, March, April, may, June in comparison with a multiyear average. The results of the comparison of the values of the monthly sums of precipitation by months in 1995 and the long-term average monthly precipitation amounts for the period 1949-2015 are shown in Fig.3.

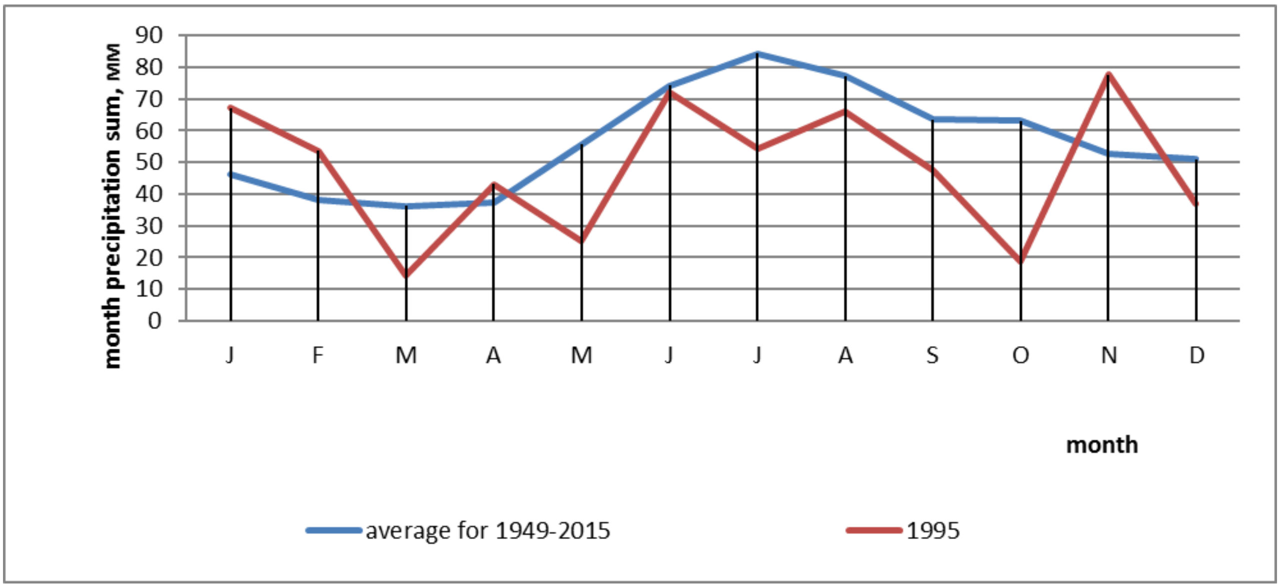

Fig 3: The results of the comparison of the monthly precipitation sums values of the by month in 1995 and the long-term average monthly precipitation amounts for the period 1949-2015.

The weather situation in 1995 characterized by a lower precipitation amount in March, May, July, August in comparison with a multiyear average. The data in Fig.3, 4 prove that in 1995 there was one form of drought. Consequently, the polymorphism in the response of radial growth in this period reflects the drought tolerance of different aspen trees.

Having considered the variability of radial growth of the studied aspen trees for the period 1973-2015 the years of extreme growth were pointed out:

1) of the local maximum growth was observed in 1979,1993,1996,2001,2005,2010,2013.
2) of the local minimum growth was observed in 2012,2008,2003,1999,1995,1992.

For local minima years and maxima of increase (years of high and low growth) were built climograma, reflecting average values of meteorological parameters for these two sample years.

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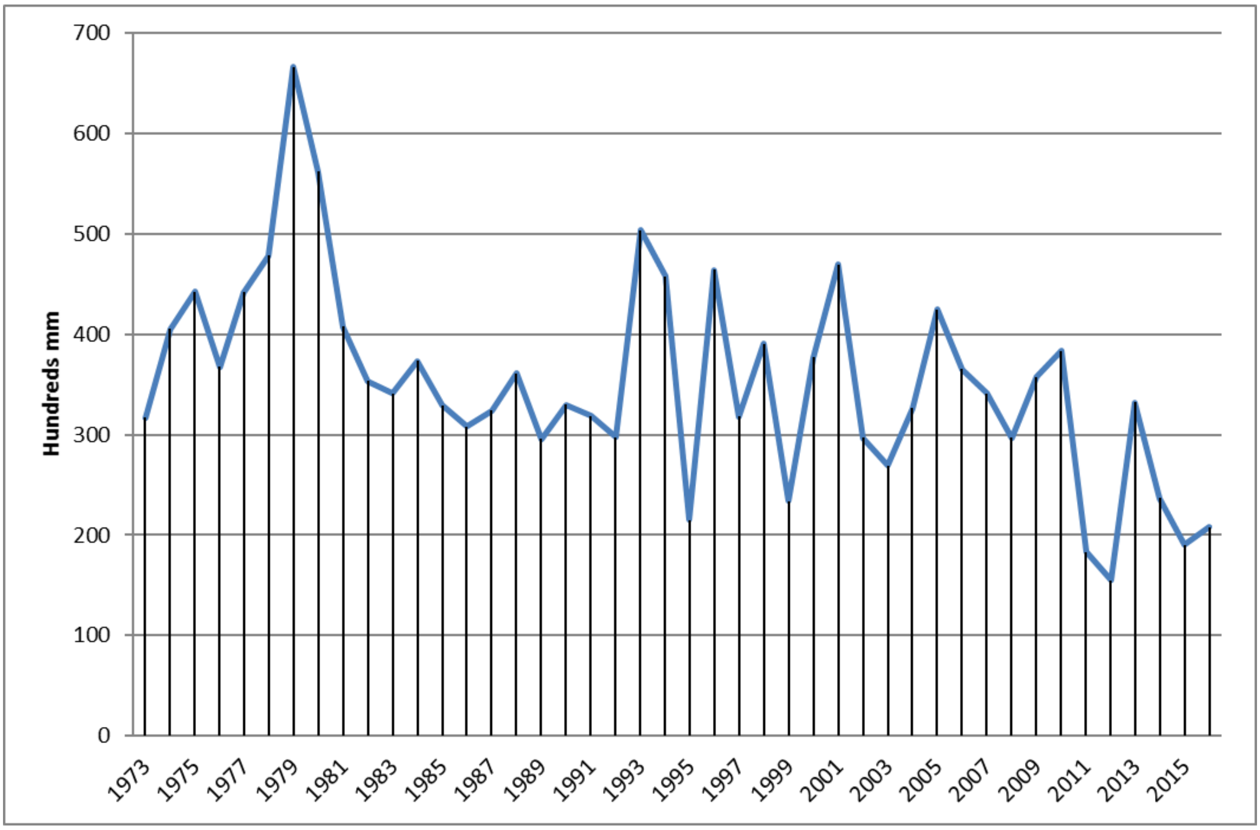
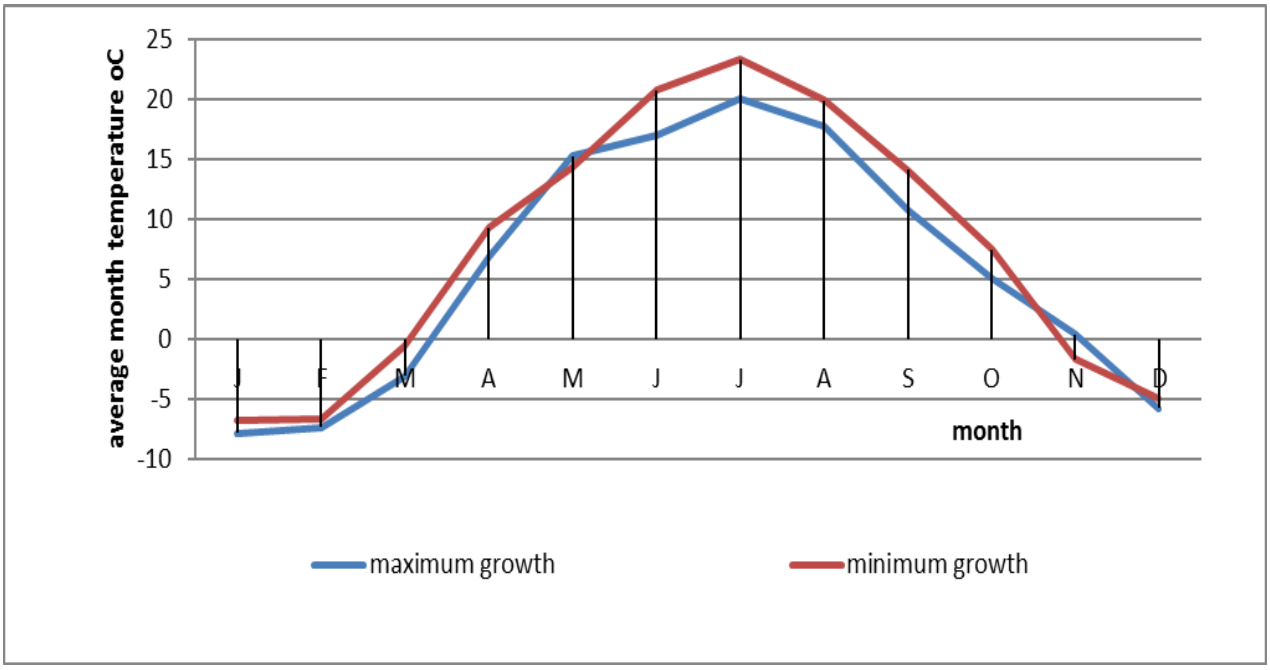
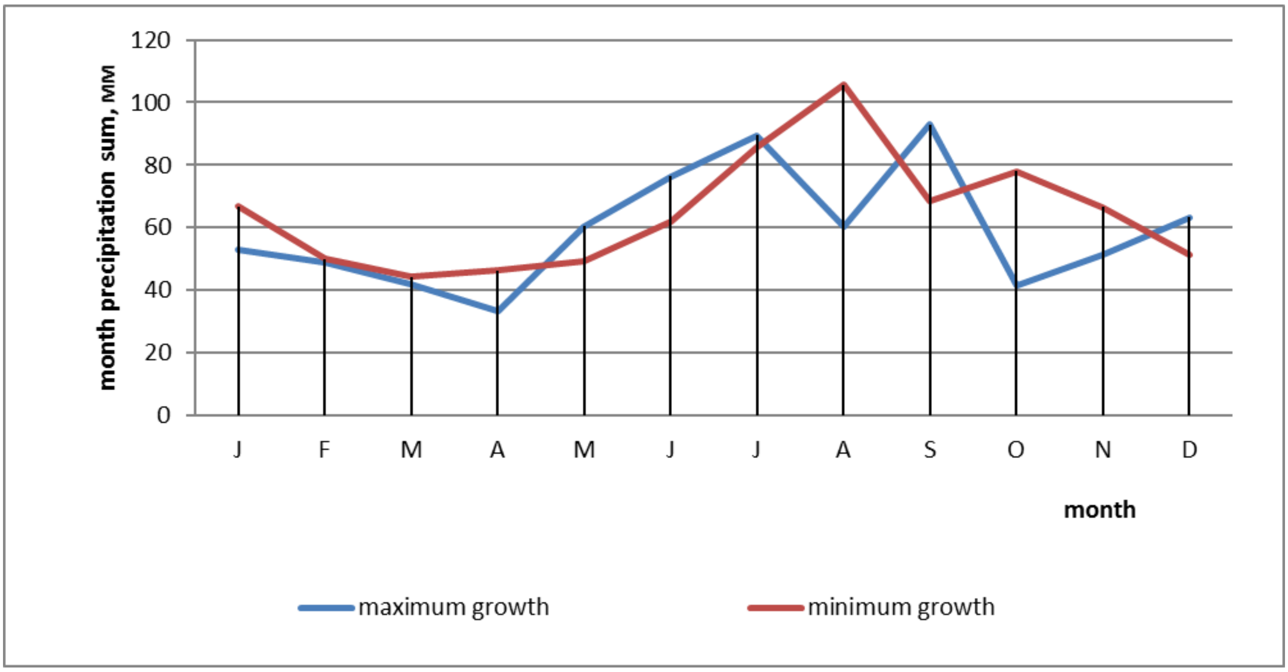


Fig 4: Average tree ring width dynamic for stand



A



B

Fig 5; The results of the comparison of monthly average temperatures (A) and monthly sums of precipitation (B) by months in the yearsof extreme high or low growth.

Years with low and high growth difference most strongly shown are between themselves by the temperatures of June, July and August (Fig.5 A). High temperature is unfavorable for growth of the investigated aspen clones and contribute to the formation of narrow annual rings.

Analyzing the impact on the increase in the month precipitation sums (Fig.5 B), it should be noted that the years of low and high growth differ by the month precipitation amount in May and June. It can be concluded that we have found that drought is one of the important factors contributing to the reduction of the current wood growth in the studied aspen plantations by the climogram analysis method.

Examining the impact the month total temperatures average on the growth increase we can notethat the biggest difference in the years of low and high growth is between the temperatures of June and July.

CONCLUSION

The data obtained on the viability of trees aspen plantations of the academician A. Yablokov and B. Vladimirov testify to the diagnostic value of the used indicators when selecting planting material for fast growing plantings taking into account the resistance to the medullary rot infection. Model tree analysis showed the lack of stem rot throughout the model tree.

Comparison of forest inventory indices of the model aspen tree with table-indicators of first capacity class aspen showed that height growth stand development is not different from the normal aspen forest capacity class growth but the diameter growth is ahead of the table values in the age interval from 20 years to 40 years by 21.2–22.6 %%.

Drought affects the data chronologies of aspen trees in planting archive.

It is necessary to improve dendrochronological analysis methods to assess the drought trees resistance and infection by rot, to select trees with high productivity.

Using the methods of dendrochronological analysis, we can choose sustainable aspen trees of different ages in natural and artificially produced clones for various purposes in fast-growing plantations. The creation of such fast-growing plantations with increased output of timber allows to solve the problem of the conservation and biodiversity of boreal forests.

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