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**GROWTH AND DEVELOPMENT OF COMMON PINE ON LANDS,
TAKEN OUT FROM AGRICULTURAL USE,
DEPENDING ON METHODS AND WAYS OF CREATION**

Here there are results of studies of common pine plantations created in 2004 by the line-hole seeding, with the help of manual and automated planting of two-year seedlings into the furrow bottom after plowing by the plow ПКЖ-70 on the plot, taken out from agricultural use. It is found out that creation of forest plantation of the common pine by sowing seeds on former agricultural lands is not reliable, because a large number of plants die in the first years of life, and the remaining plants occupy the area unevenly, arranged in rows of clumps. Pine plantations created with the help of manual and automated planting grow successfully and at the age of 7 have no significant differences in taxation indices.

Introduction. Forest plantations play an important role in reforestation and forest-growing. It is appropriate to create forest plantations in cases when condition of forest growing do not ensure natural reforestation or it is very difficult, and also at forest-growing on plots where there was no forest before.

Depending on ecological conditions of forest plantation areas, on biological peculiarities of tree species being grown and on economic expediency there are two basic methods of forest plantations creation: by sowing of seeds and by planting seedlings, saplings and cuttings [1].

Method of forest plantations creation has a significant influence on their growth and productivity. So, in 30-year-old forest plantations created by different methods, L. F. Ipatov observed the advantage of sowings according to the preserved pine trees number on 72.8%. According to the other taxation indices sowings were worse than plantings: according to average height on 18.9%, according to average diameter on 29.5%, according to reserve on 16.7%. By the age of 46 the leveling of taxation indices differences was observed mainly because of die-off of considerable quantity of thin trees in sowings. However the advantage of plantings remain: according to the pine average height on 9.7%, according to average diameter on 15.4 %, according to reserve on 2.4% [2, 3].

Studies of M. D. Merzlenko and R. K. Muhamedshinain the bilberry pine forest of V–VI classes of age showed that both methods of pine plantation creation (sowing and planting) permit to receive high-quality forest stands with close values of productivity by the age of ripeness. However, comparison of average diameters shows that in the planted plantations the average diameter is bigger than in the sown ones. Such dependency is caused by the considerable difference of initial density of plants. Sown plantation had higher initial density than the planted plantations. According to the authors, the denser the plantations at the initial stage, the bigger the trunks and quality of wood in the

ripe forest stands, but the less yield of the large industrial wood. However, plantations differ at the age of ripeness by major vital potential, by considerable basic increment and by bigger expected longevity [4].

It is recommended by the Manual on reforestation and forest-growing in the Republic of Belarus [5] to create forest plantations of common pine by sowing on weakly weedy, easy fresh and damp sandy and sandy loam soils in the growing conditions A₂–A₃, B₂–B₃. Creation of plantations by sowing coniferous species is not permitted on dry and too moistened soils.

Main part. The pure pine plantations were studied, created in 2004 on the plot, which was used earlier in agriculture on the territory of Negereloe teaching-experimental forestry enterprise. While creating plantations the soil processing was done in the spring by furrows using the plough PKL-70 in the assembly with tractor MTZ-82 on depth of 8–10 cm. The first variant of experiment stipulated the manual planting of 2-year-old common pine seedlings into the furrow bottom using the sword of Kolesov. The second variant included the automated planting of 2-year-old common pine seedlings into the furrow bottom by the tree planting machine MLA-1A. Density of plants planting in both cases was 5000 pieces/hectare, planting places location was 2×1 m. In the third variant there was line-hole seeds sowing of common pine of II quality class by the sowing unit to plough PKL-70 in the furrow bottom simultaneously with soil plowing. The holes pacing at seeds sowing was 60–70 cm.

The soil was inspected for white grub infection and it was found out that pests population was above admissible. Therefore, mixture of clay and aqueous solution of the drug Karate was used, in which the root system of seedlings was dipped before planting to fight the rhizopagous soil pests.

The soil on the plot is sod-podzol, weak sod-podzol, sandy loam, developing on friable sandy loam, replaced by friable sand, and from the depth

of more than 0.5 m is spread by average drift clay.

At the moment of plantations examination (variant 1) preservation was 87% (4300 pieces/hectare), in variant 2 – 85% (4250 pieces/hectare).

At the plantations created by sowing (variant 3), the amount of trees on a hectare at the age of 7 was 720 pieces. Trees of common pine on this plot grow non-uniformly, are placed in lines of clumps of 3–10 pieces, the distance between clumps in a row is from 5 to 22 m, in row-spacings – 2–10 m.

A. N. Prahodsky and M. K. Asmolovsky found out that pine plantation creation by seeds sowing is not always is reliable and it is necessary to use this method taking into account both the place growing conditions and weather factors. So, in experimental plantations a month after their creation the sown pine seeds did not give shoots. Because of abundant and prolonged precipitates the seeds were covered by a thick dense layer of sand. At digging it was found out that the seeds depth was more than 3–4 cm, and it led to death of the formed sprouts [1].

Statistical processing results of growth and development indexes of pure pine plantations during the 7th year of cultivation are given in Table 1.

Usage of the planting and sowing method while creating plantations in one year and on the same plot led to comparison impossibility of taxation indices of variants 1, 2 with variant 3 because of different biological age.

So, the pine trees in plantations created by sowing (variant 3), at the moment of studying had the biological age of 7 years, the average height of 2.5 m, the average root collar diameter of 6.5 cm and the average height increment of 47.9 cm.

Woody plants at the plantations created by manual and automated planting (variant 1, 2), at the moment of studying already reached the biological age of 9 years and had the average height of 3.1–3.3 m, the average root collar diameter of 7.3–7.9 cm and the average height increment of 64.1–70.5 cm.

Significant difference according to the average height and height increment was found out in vari-

ants with manual and automated planting of forest plantations. The average height and height increment of pine in the variant with the automated planting was 20 and 6 cm bigger accordingly in comparison with the variant where manual planting was used.

Digging of the test trees root systems was done 5 times to determine the influence of methods and ways of creation of artificial plantations on the space extending of roots of woody plants at the plantations under study on the former farmlands. The qualitative (morphological) method – the “skeleton” method [6] was used to study the root systems.

According to studies of A. I. Rusalenko, the root system development occurs in those soil layers where roots fulfill their main purpose supporting the plant with water and mineral substances with the least energy expenditures. Besides, a certain concentration of oxygen is necessary for normal functioning of roots in the soil solution. Top soil corresponds to the requirements to the greatest degree [7].

The amount of moisture and feeding elements, available to a plant, is determined by two main factors – by the structure of root system permitting it to occupy certain volume of soil space, and by properties of the soil space itself which is also characterized by a certain structure and properties. [8].

The root systems digging results of woody plants at the forest plantations are given in Table 2.

Woody plants growing on the plantation plot created by the method of automated seedlings planting into the furrow bottom have the greatest radius of extending of horizontal roots in the humic horizon: pine roots here reach the length of 215.1 cm.

Then there is the variant with usage of manual seedlings planting into the furrow bottom, here the length of the pine horizontal roots reaches 196.4 cm. At the plantations created by the line-hole seeds sowing into the furrow bottom, the radius of extending of the pine horizontal roots reaches 81.9 cm.

Table 1

Characteristic of common pine plantation created on the lands taken out from the agricultural use

| Variant | Average indices | | | | | | | | | | | |
|---------|-----------------|---------|---------|------------|--------------------------|---------|---------|------------|----------------------|---------|---------|------------|
| | Height, m | | | | Root collar diameter, cm | | | | Height increment, cm | | | |
| | $M \pm m_M$ | $V, \%$ | $P, \%$ | $t_{0.95}$ | $M \pm m_M$ | $V, \%$ | $P, \%$ | $t_{0.95}$ | $M \pm m_M$ | $V, \%$ | $P, \%$ | $t_{0.95}$ |
| 1 | 3.1 ± 0.08 | 26.4 | 0.2 | – | 7.3 ± 0.26 | 36.0 | 0.5 | – | 64.1 ± 1.93 | 30.1 | 3.8 | – |
| 2 | 3.3 ± 0.07 | 21.8 | 0.1 | 2.09 | 7.9 ± 0.25 | 31.4 | 0.5 | 1.54 | 70.5 ± 1.93 | 27.3 | 3.8 | 2.36 |
| 3 | 2.5 ± 0.13 | 30.5 | 0.3 | × | 6.5 ± 0.37 | 33.1 | 0.8 | × | 47.9 ± 3.19 | 38.3 | 4.6 | × |

Note. M – arithmetic mean value of criteria; m – error of arithmetic mean value; V – correlation factor; P – determination accuracy of average value; t -criterion – the calculated Student's test (the standard value of Student's test is $t_{0.05} = 1.96$); × – reliability of differences was not determined because of different biological age.

Table 2

**The root systems digging results
of woody plants at the forest plantations**

| Variant | Roots extending in directions (min – max), cm | |
|---------|--|------------|
| | Horizontally, m | vertically |
| 1 | 137.6–196.4 | 39.4–55.1 |
| 2 | 145.4–215.1 | 40.2–53.5 |
| 3 | 79.3–81.9 | 34.7–47.8 |

At the plantations under study the penetration depth of pine roots according to the variants of the experiment reaches 47.8–55.1 cm. It is stipulated by the fact that the main pine roots have already reached the dense soil horizon presented by average loam, and their further penetration will be impeded.

Conclusion. The studies permit to draw a conclusion that pine plantations creation by the line-hole seeds sowing into the furrow bottom on the sandy-loam soil on the former agricultural plot is not reliable. Because of abundant and prolonged precipitations the sowings which are at the furrow bottom, can be covered by the washed off ground and that leads to increase of the depth of seeding and the formed sprouts die-off under the deposited dense layer of soil. In the given conditions the sprouted woody plants during their first years of growth often do not meet continuous competition with herbaceous vegetation and that leads to their lag in growth and to death. The pine plantations created by planting grow successfully. The growth indices results analysis also showed the significant difference on the average height and height increment in the variants with the manual and automated planting of forest plantations. The average height and height increment of pine in variant with the automated planting was 20 cm (6.5%) and

6 cm (10%) bigger accordingly in comparison with the variant where manual planting was used. It is because in the variant of plantations created with the usage of the automated planting the woody plants developed more powerful root system in the humic horizon by the age of 7 years.

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