Estimation of the Survival Rate of Pinus Sylvestris Urban Landscaping Facilities in the City of Krasnoyarsk

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Abstract. Scotch pine takes an increasing place in urban greening. Its high decorative qualities, especially in winter, undemanding to soil conditions, rapidity of growth, winter hardiness, high sanitary and hygienic and environmental protection properties contribute to the greatest distribution. It has been established that when creating green spaces at city greening objects, it is necessary to take into account the dynamics of plant survival. The study of the survival rate of Scots pine according to the reaction of the growth of lateral branches showed that the main decrease in growth after transplantation occurs in the second year, the restoration of growth occurs after 7-8 years. The survival rate of plants largely depends on the state of the urban environment and the technology after planting care for plantings, especially in the first and second years after transplanting. At the same time, when creating green spaces, it is also necessary to comply with the recommendations of the "Building codes and regulations" in relation to the minimum distances to buildings, structures, footpaths and driveways, as well as the schedule of work to create a landscaping facility.

1. Introduction
Scotch pine takes an increasing place in urban greening. The greatest distribution is facilitated by its high decorative qualities, especially in winter, undemanding to soil conditions, rapidity of growth, winter hardiness, high sanitary and hygienic and environmental protection properties [1, 2, 5]. An evergreen tree, reaching a height of 35 m, with a trunk diameter of up to 80-100 cm. In dense plantings, the tree has a straight, highly de-branched trunk with a compact crown in its upper part. Separate trees have a spreading crown, evenly located along the entire trunk. The bark is light, reddish-brown, fissured, yellowish on the young parts of the trunk and branches. All this made it a classic breed for landscaping medical and prophylactic, children's, educational institutions, parks, squares, squares, and other urban areas [1, 4].

However, a significant part of Scots pine plantations has disadvantages typical for urban landscaping as a whole - these are dense plantings, bio ecological incompatibility of trees growing nearby, non-compliance with the recommendations of the Building Norms and Rules regarding minimum distances to buildings, structures, footpaths and driveways. For these reasons, oppressed forms of trees are often formed, various defects of the crown and trunk are formed.
The close location of pine plantations to the carriageway of highways with heavy traffic leads to a sharp deterioration in the condition of the trees, which leads to drying out of skeletal branches, tops, and sometimes to the death of plants. The inevitable impact on the growth and development of pine plantations is exerted by heavy soils, technogenic pollution of the environment, a complex of urban planning conditions, and recreational loads. Rapid aging of pine is noted in the conditions of street gardening in various cities [1, 3].

2. Objects and methods of research
Recently, Scotch pine has been increasingly introduced into the landscaping objects of Krasnoyarsk. At the same time, its acclimatization in various urban areas occurs in different ways. We have conducted a study of the survival rate of Scots pine by the reaction of the growth of lateral branches. Scots pine trees growing at urban landscaping facilities in Krasnoyarsk, with different levels of technogenic loads on landscaping facilities, from satisfactory (with the least environmental impact on the state of plants) to critical (with the maximum impact of transport and industrial emissions on urban plantings). Landscaping objects are located in the following districts of the city: Udachny settlement (a suburb of the city, located in the most ecologically clean area of the city) - the level of technogenic loads corresponds to satisfactory; Pobediteley Square (located in the Central District of the city of Krasnoyarsk, softening of growth conditions occurs due to the large area of the park - 10 hectares) - the level of technogenic loads corresponds to the intense; public transport stop on Krasnoyarskiy Rabochiy Avenue - conflict; in the squares near the shopping and entertainment centres Leroy Merlin (KrasTETs.) and Planet (9 May St., 77) - the conditions for the growth of green spaces on the data are assessed as critical, since they are located in areas with a high level of pollution from vehicles, industrial facilities, recreational load. The nursery of the Krasnoyarsk Green Building Administration, located in Sukhobuzimskoe, 50 km from Krasnoyarsk - the level of technogenic loads corresponds to satisfactory.

3. Results of research
To analyse the structure of lateral branches and develop models of pine survival on different objects, model crown branches were used at a height of 1 meter from the soil surface, equally directed outward from the southern side of the plant. The age of the branches ranged from 7 to 10 years and at least 6 years after the plant was transplanted to the planting object, the length of the branches ranged from 1 m to 2.4 m. For each branch studied, three-dimensional models were developed in the Compass 3D and SolidWorks programs.

The research results showed that on all branches there is a decrease in the growth of lateral branches, but to a different extent. A decrease in growth occurs already in the first year after plant transplantation. At the same time, the largest decrease is observed in the second year after the transplant and is at facilities with a low level of urban pollution - 46% in the first year of the increase in the year preceding the transplant, and 67% in the second year after the transplant. Starting from the third year, there is an increase in growth and by the 8th year it reaches the value of the branch growth before plant transplantation. On objects of landscaping with a more complex technogenic load, the survival rate of pine trees is slower.

The dynamics of the growth of a side branch growing in a public garden of a city with a tense level of pollution, but with regular after planting care, showed that plants decrease in the first two years by 62% in the first year, by 88% in the second. By the 8th year after transplanting, the growth is practically restored, its decrease is 15 -20% of the value of the branch growth before plant transplantation.

The decrease in growth in conflict conditions of the urban environment (at a public transport stop) was 85% in the first year, 89% - in the second, and in the third year - 77%. However, at this facility, the growth rate in subsequent years remained at the level of 20 - 25% of the increase before transplantation. Under these conditions, there was no maintenance after planting, and a new footpath was laid, which violated the root system of the plant, further weakening the plants.
In especially polluted conditions of the city, a decrease in growth in the second year after transplantation, the maximum decrease in growth is up to 99%, there is practically no branch growth, there is a dense and increased length of needles growth. In the third year, there is an insignificant increase in growth (the decrease is from 50 to 60%). However, in subsequent years, the growth rate decreases again and on average amounts to 75% of the branch growth value before plant transplantation. At the same time, it should be noted that if technological methods for caring for plantations are carried out (watering, washing crowns, lawn mowing, mulching of tree trunks, the use of growth stimulants, especially in the year of transplantation), then the growth of branches increases. So, on the territory of the Planet Shopping and Entertainment Centre, these activities were carried out, respectively, and the growth of plants at this facility is 20-25% higher.

The growth of pine branches growing in a nursery located 50 km from the city continues to increase, the increase in growth is from 7 to 20%.

4. Conclusion
Thus, when creating green spaces at city landscaping objects, it is necessary to take into account the dynamics of plant survival, which largely depends on the state of the urban environment, as well as on the technology after planting care of the plantings, especially in the first and second years after their transplantation. At the same time, when creating green spaces, it is also necessary to comply with the recommendations of the "Building codes and regulations" in relation to the minimum distances to buildings, structures, footpaths and driveways, as well as the schedule for the creation of a landscaping object - first, planning and construction work is carried out, then planting.

5. References
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