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How to Increase the Timeframe for the Planting of Tree Seedlings and Improve Their Survivability

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Modern forest management requires higher quality of tree seedlings and the restoration of forests which are affected by global warming which has caused a shortening of the optimal springtime planting season. For these reasons, it is extremely important to develop new and improve traditional methods of conservation, preservation, and transportation of planting material.

Extending deadlines for planting of tree seedlings depends on temperature and humidity of the soil, and the amount of rainfall and air temperature after the crops are planted. There are several ways to expand the timeframe for the planting of tree seedlings:

- Slowing the development of tree seedlings by artificially cooling them
- Using of more developed tree seedlings a technique developed by V.E. Schmidt
- Working with seedlings and saplings with the closed and semi-closed root systems
- Stimulating the recovery and development of the root systems by growth substances and moisture preserving mulch
- A combination of the above methods that includes the inhibition of growth, the regulation of root to leaf proportions, and the application of growth stimulants, are the other ways for extending tree seedling planting times.

The application of the various techniques outlined above is driven by their costs. The effectiveness of the above methods depends on various factors. A thorough search for ways to improve existing methods and develop new approaches to expand the terms of planting forest crops is not possible without additional specialized research. One such research study is on the effectiveness of rehabilitation of planting material (seedlings) with open injured root system by restoring the proper root to leaf proportions damaged during their excavation.

An experiment tested the effectiveness of rehabilitated seedlings during storage by rearing the seedlings in rolls on 7 different variations at the site of the substrate culture container (SCC) and temporarily stored on the ground loosely covered with earth. The duration of this technique was 2, 4, and 6 weeks after the normal growing period.

The Reforestation and Afforestation Department of the National University of Life and Environmental Sciences of Ukraine conducted the trial on the educational and research nursery

and Pershotravneviy Forestry Enterprise "Kiev Forest Research Station" conducted the trial on the neighborhood 79 block. Both entities worked with experimental-industrial culture of Scotch pine seedlings with open ground for sowing, with the other being temporarily stored on the ground loosely covered with earth (control), and rehabilitated seedlings according to variables of the experiment.

According to our hypothesis, the effectiveness of rehabilitated seedlings with open root systems by using developed technology primarily depends on slowing the spring development of tree seedlings in the rearing of an adequate substrate (the favorable impact of its structure on the regeneration of physiologically active roots). The studies revealed certain patterns which allowed us to make evidence-based conclusions.

Our research has established that apostasy and survival rate of rehabilitated seedlings in cultures established in spring and summer time under suboptimal conditions significantly affect the duration of their growth. This was accomplished by slowing the growth processes of above ground parts and activation of regeneration of injured root systems. Other factors include the composition of the substrate and soil quality where the seedlings are planted. The least amount of apostasy in seedlings was observed in the variance with the short-term (2 weeks) and medium-term (4 weeks) during recovering growth of excavated seedlings. Slightly larger apostasy was noted in plants recovered within 4 weeks by using the aforementioned substrates, respectively 20-33%; 37-40%; and 60-68% under control.

The study revealed a clear tendency for efficient seedling recovery with injured root systems by using a substrate culture container with artificial irrigation. This was clearly noted with variations of the substrate with a high content of saw dust compost to prevent soil drying. Significant positive impact of a substrate mix of added with upland and lowland peat were observed on the rehabilitated seedlings with injured root systems. This technique enhanced its water-holding capacity and, thus, improved moisture content to the plants during their recovery.

The survey results indicate that inhibition of the growth processes of the above ground parts of seedlings and the regeneration of the root systems injured by digging to full recovery lasted more than 4 weeks and led to the weakening of the plant as evidenced by the high rate of their apostasy within the range of 83-100% despite of the substrate modifications and the forest soil quality.

To some extent, we can state that the survival rate of recovered plants in areas of the forest ecosystem characteristics is affected by the presence of mycorrhizaed soil in the substrate.

Rehabilitation of seedlings by inhibition of growth processes of above ground parts of seedlings and the regeneration of injured root system after digging allows extending the normal growing period by 2-4 weeks and, thus, resulting in less apostasy of planted seedlings.

The quality of rehabilitated seedlings under the proposed method is significantly affected by the composition of the substrate and especially the adequacy of soil moisture throughout the growing period that is favorable for the regeneration of injured root systems.

To optimize the composition of substrate for rearing seedlings with open root systems during their rehabilitation, it is appropriate to use the proper components which enhance moisture and mycorrhizaed soil which in turn help in releasing minerals to the plants.