

LARCH PHENOLOGY FEATURES IN THE RUSSIAN PLAIN CENTER

Anastasia Martynenko¹, Petr Melnik¹

¹Bauman Moscow State Technical University (National Research University) – Mytishchi Branch, 1, 1st Institutskaya st., 141005, Mytishchi, Moscow reg., Russia

Abstract: *The article presents the phenological observations results of European larch (*Larix decidua* Mill.) at two locations. Self-seeding and undergrowth of natural origin European larch on the protected area territory «Nikolskaya Lesnaya Dacha» (Moscow Region northeast) and larch alley, planted in 2005 on the territory of the Bauman Moscow State Technical University (Moscow Region center) were studied. Observations have been continuous since the spring of 2024 to the present to generally accepted methods combination. Based on the first growing season research results, a phenological spectrum has been compiled for each location. It has been established that European larch has successfully adapted to the introduction conditions and can be recommended for breeding in Moscow region forests and parks. The presence of evergreen needles of self-seeding larch, overwintering under the snow, was noted. In order to confirm the results, observations at the locations will continue over the next few years.*

Key words: *European larch, *Larix decidua* Mill., the introducer, phenology, Moscow region.*

Introduction

European larch (*Larix decidua* Mill.) is a large coniferous tree, differing from other trees in this phylum by the needles annual renewal. This is one of the few species that feel good in urban conditions. European larch withstands air smoke, is unpretentious in care and tolerates crown cutting well. It retains its decorative qualities for most of the year and secretes phytoncides that have a beneficial effect on the human body.

European larch is an introduced species in the European part of Russia. This fact is often the main barrier to the introduction of larch into forest plantations. However, you should not be afraid of using larch crops as an introducer. In our conditions, it does not exhibit invasive properties and can be renewed naturally. According to the Doctor of Biological Sciences, G.A. Polyakova, the renewal of introduced plants in urban parks and forest parks is highly desirable, since such species are most often resistant to high recreational loads [1]. Professor V.P. Timofeev in the article "Restoration of coniferous forests of the Moscow region" talks about green areas around cities. In his opinion, spruce and pine forests, which we consider indigenous and try to thoughtlessly restore by planting monocultures, appeared here in conditions completely different from modern ones: in the absence of increased gas pollution, soil pollution and recreational stress. Nowadays, these species which do not tolerate air pollution well, can't longer perform their protective functions longer. Therefore, the professor suggests using unusual forestry methods to solve the problem of landscaping

suburban areas. First of all, he suggests introducing woods and shrubs that are resistant to modern conditions into urban plantations. In his experience, European larch (*Larix decidua* Mill.), Siberian larch (*Larix sibirica* Ledeb.) and Sukachev larch (*Larix sukaczewii* Dylis) turned out to be the most resistant of coniferous species [2].

It is also useful to use larch in forest plantations. It has long been proven that pure coniferous plantations, which are commonly planted now, have an increased fire risk. The use of larch as part of the forest plantation will reduce this risk without losing the value of the plantation.

The purpose of this work is to assess the success of European larch adaptation to the conditions of introduction (the Moscow region center and northeast) by studying its phenological development in forest and urban conditions. Knowledge of phenological patterns is essential for creating the scientific foundations of forestry and nature protection [3, 4]. Our research will serve as a scientific justification for the inclusion of larch in the protective forests of the Moscow region.

Material and methods

Objects of research

Studies of the larch seasonal development features were carried out on the two objects territory – in forest conditions: of the protected area territory «Nikolskaya Lesnaya Dacha», located in the Vorya-Bogorodsky district forestry of the Moscow Educational and Experimental Forestry, and in urban conditions: of BMSTU (Mytishchi Branch) territory (Fig. 1).

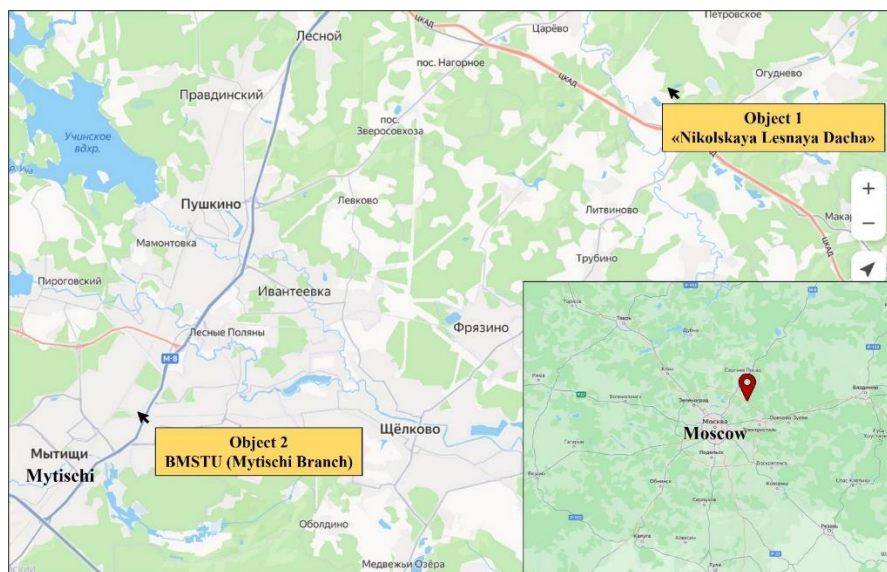


Figure 1. Geographical location of the research objects

The objects of the study are 102 specimens of natural origin self-seeding and undergrowth European larch (*Larix decidua* Mill.) «Nikolskaya Lesnaya Dacha», as well as 24 European larch (*Larix decidua* Mill.) mature trees planted in 2005 and 12

Sukachev larch (*Larix sukaczewii* Dylis) young trees planted in 2015 on BMSTU (Mytishchi Branch) territory.

Methodology

In the course of our work, we analyzed and compared three conducting phenological observations methods: the conducting phenological observations methodology of the Russian Geographical Society [5], conifers phenological observations program (№3) of the Nikitsky Botanical Garden (Yalta) [6] and the conducting phenological observations of larch methodology of the Botanical Garden of the Southern Federal University (Rostov-on-Don) [7].

As a result, the program of larch phenological observations for our study included the following phenophases: swelling and blooming of generative and vegetative buds, pollen, as well as separation, yellowing and falling of needles [8].

The observations were carried out once a week throughout the growing season. The phenological phase was considered to have begun if its signs appeared in at least one of the studied trees; to have occurred if its appearance was observed in 50% of the studied trees; to have ended if it occurred in more than 90% of the studied trees. In addition to the phenophases onset, biometric measurements of annual growth in self-seeding and undergrowth, and lateral shoots in mature larch trees were carried out throughout the growing season.

Methods of Analysis

To assess the phenophases passage efficiency by larch, calculations were carried out using the variational statistic method [9]. The results of the field research were processed on a computer using the MS Office 2021 software package, namely MS Word, MS Excel and MS PowerPoint.

Results and discussion

The experimental part

The 2024 field season in Nikolskaya Lesnaya Dacha lasted from April 12 to November 20. On April 12, 2024, snow hadn't everywhere melted yet in Nikolskaya Lesnaya dacha, and an interesting feature was noticed of the larch self-sowing. On plants that were completely covered with snow for most of the winter, last year's green needles specimens were preserved at the branches ends (Fig. 2).



Figure 2. Green needles on self-seeding larch (photo on the left – November 2024, on the right – March 2025)

The phenomenon of last year's green needles described in the experimental part is found in the literature [10, 11] and may indicate that the European larch ancestral forms were evergreen, like the vast majority of coniferous plants.

All vegetative spring phenophases ended on May 17th. The annual growth measurement was carried out from the end of April to the end of September. It is noticeable that due to heavy rainfall in early August (8 millimeters of precipitation fell in the first half of the month), all larch specimens showed the presence of secondary growth of needles and lateral shoots. On September 5, the first signs of needles yellowing were recorded. It is noted that in more humid microclimatic conditions, European larch turns yellow later, with the onset of a steady nighttime cooling. Larch specimens growing in more arid conditions begin to shed browned, dried needles, bypassing through the yellowing phase. At the same time, the needles remaining on the branches can remain green for a long time. So, on October 9, most of the still green larch specimens crumbled in the lower part, while mass crowns yellowing (more than half of the crown of each tree) was noted only at the end of October. In 2024, autumn was quite warm, so observations continued until November 20, when the needles turned yellow and crumbled from almost all the undergrowth. By that time, only two self-seeding specimens had preserved a significant part of the green crown, while the rest of the plants had green needles only on annual shoots.

It's noticeable that natural origin self-seeding of European larch begins and ends vegetation one week later than the undergrowth. In our opinion, this is due to the difference in temperatures at the soil surface and at the crown level of the undergrowth. So, in spring, the temperature at the soil surface is lower than above, so

the buds of self-sowing wake up later. In autumn, on the contrary, the soil retains heat longer, so low larch specimens stay green longer.

As is known, in urban conditions, the plants seasonal development begins earlier than in the forest [7]. In Mytishchi, the 2024 field season lasted from March 30 to November 9. The onset of all spring phenophases was recorded on April 22. The lateral shoot growth measurement in 2024 was started on May 6. It is noticeable that in most of the studied larch specimens, the shoots growth ended already at the end of June. In August, a significant increase was noted in only one specimen of Sukachev larch and in two specimens of European larch. Thus, there was a rather long period between the end of growth and the first larch yellowing, when there were no visible changes. The first yellowing of European larch was noted in mid-August. Sukachev larch began to turn yellow a week later. The massive larch yellowing, when most of the needles on each tree turned yellow, occurred on October 11. A month later, on November 9, most of the European larch trees (21 out of 24) shed their needles. At that time, there were still yellow needles on the Sukachev larch.

Based on the results of the first phenological observations season, a phenological spectrum was compiled for European and Sukachev larch at each of the studied sites. In addition, annual growth schedules of larch trees were compiled by month.

The growing season duration of young European larch in forest conditions in 2024, according to the spectrum (Fig. 3), was 194 days.

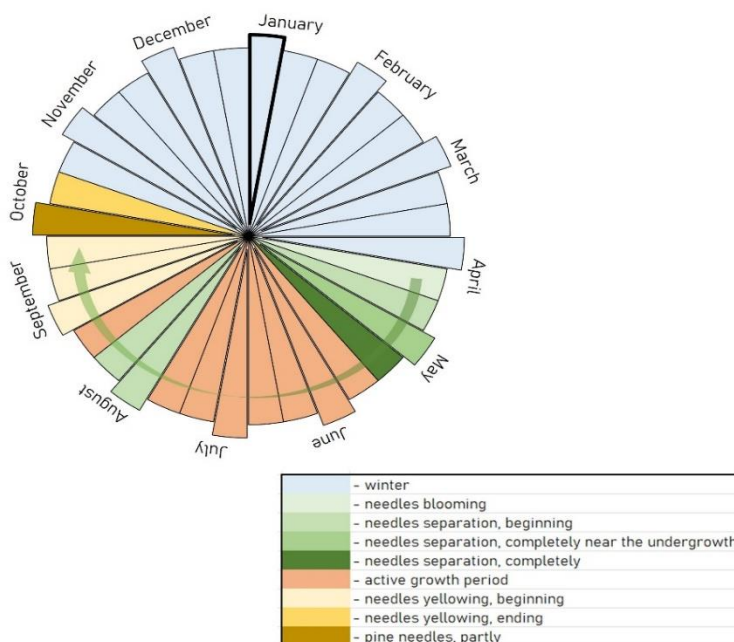


Figure 3. Phenological spectrum of young European larch in forest conditions (2024)

The active growth peak of the young larch tops occurred in June-July, while the undergrowth has a higher growth energy than self-seeding. The average growth of annual shoots by the end of the growing season was 31.4 cm in undergrowth and 19.0 cm in self-seeding (Fig. 4).

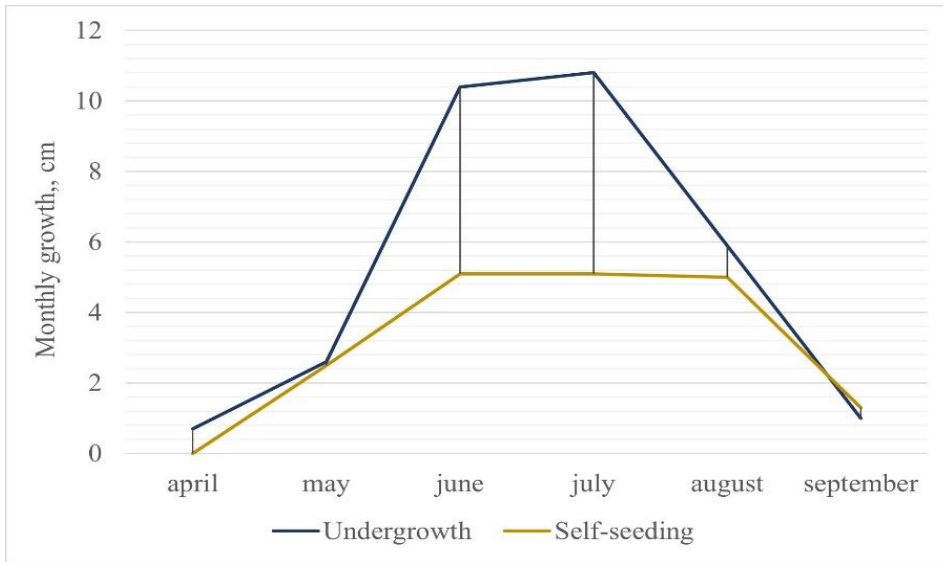


Figure 4. Annual growth of young European larch in forest conditions (2024)

According to the results of the first observation season in Mytishchi, the growing season duration of European larch from bud swelling to pine needles was 216 days (Fig. 5). This is consistent with the data of professor V.P. Timofeev, who argued that in the second and third European larch generations, the needles turn yellow and fall off 7-8 and 10-12 days earlier (respectively) compared to the parent seedling grown from seeds originating from Western Europe [10].

The growing season duration of Sukachev larch was 225 days (Fig. 6). It is noticeable that N.V. Dylis [12] and V.P. Timofeev [10] in their works pointed out that the European larch turns yellow and sheds its needles 2-3 weeks later than the Sukachev larch. Perhaps the reason for the shorter growing season of European larch is explained by the dry summer, which disrupted the normal growth process of the studied trees.

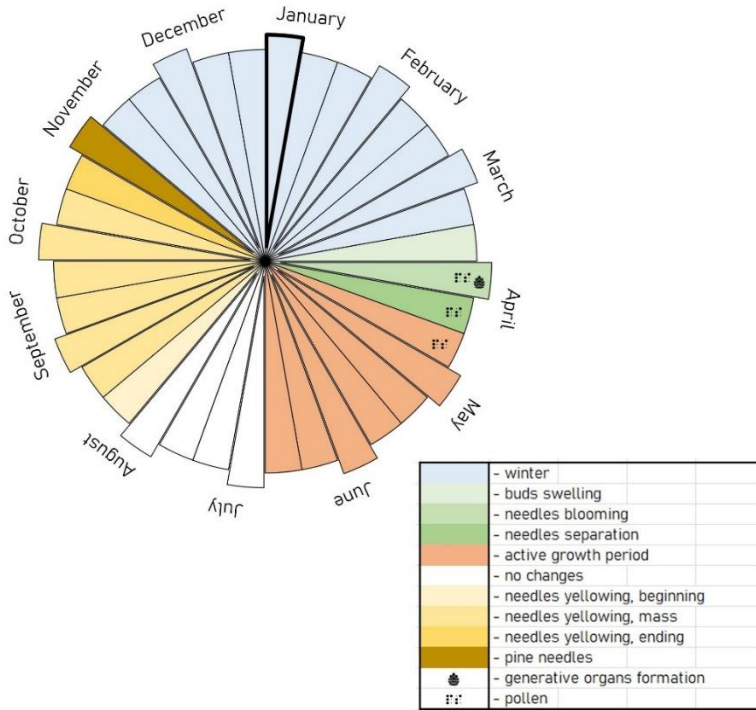


Figure 5. Phenological spectrum of European larch in urban conditions (2024)

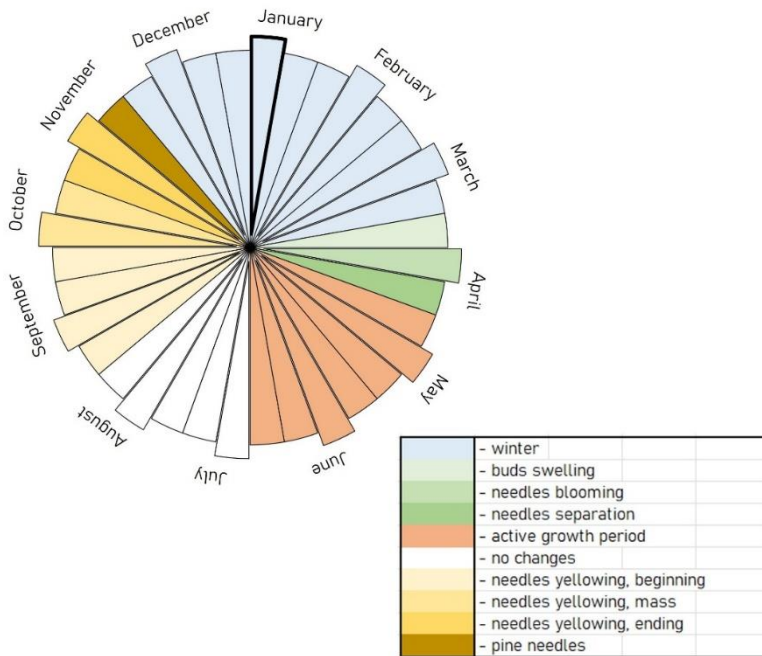


Figure 6. Phenological spectrum of Sukachev larch in urban conditions (2024)

In 2024, the larch at the studied site had intensive growth of lateral shoots until mid-June, but the growth process ended early enough, long before the end of the growing season (Fig. 7).

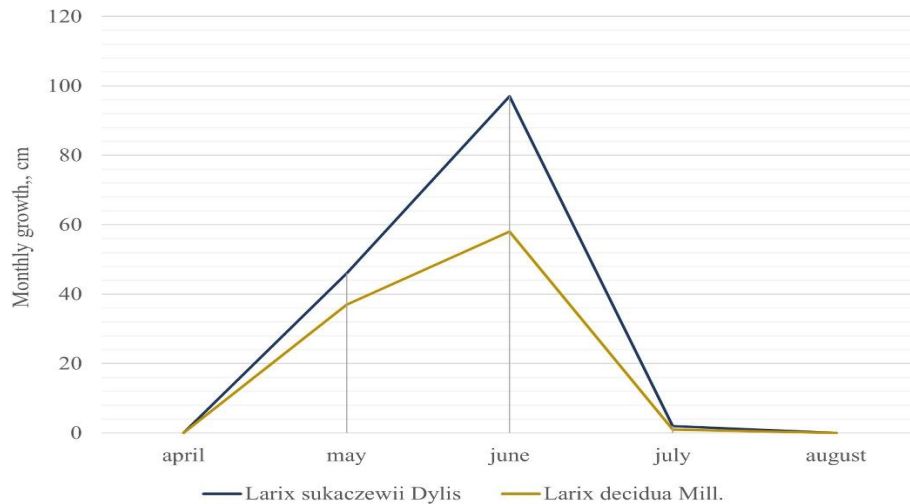


Figure 7. The larch lateral shoots growth in urban conditions (2024)

In 2024, the average annual growth of lateral shoots was 9.6 cm for European larch and 14.5 cm for Sukachev larch.

Conclusion

Based on the conducted phenological studies results, the following conclusions were drawn. The growing season duration of European larch (*Larix decidua* Mill.) in the Russian Plain center conditions in 2024 was: the natural origin young European larch in forest conditions has 194 days, and the adult European larch in urban conditions has 216 days.

Natural origin self-seeding of European larch (*Larix decidua* Mill.) begins and ends vegetation one week later than the undergrowth due to the difference in temperatures at the soil surface and at the crown level of the undergrowth.

The growing season duration of Sukachev larch (*Larix sukaczewii* Dylis) in urban conditions in 2024 was 225 days. Thus, under the conditions studied, Sukachev larch retains its decorative qualities for a week longer than European larch.

In 2025, phenological observations at the facilities are continuing in order to confirm the reliability of the results obtained in the first season.

Thus, the study of the seasonal development of natural and cultural origin European larch (*Larix decidua* Mill.) under the introduction conditions showed that this species has successfully adapted to the Russian plain center conditions. In urban conditions, European larch retains its aesthetic appeal for 2/3 of the year, is resistant to air pollution and recreational stress. All this makes it possible to recommend European

larch for more active use as part of forest, parkland and urban plantations in the Moscow region.

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FENOLOŠKE KARAKTERISTIKE ARIŠA U USLOVIMA MOSKOVSKJE REGIJE

Anastasija Martinenko¹, Petar Meljnik¹

¹Moskovski državni tehnički univerzitet Bauman (Nacionalni istraživački univerzitet) – Mytishchi Branch, 1, 1st Institutskaya st., 141005, Mytishchi, Moskovska regija, Rusija

Sažetak. U radu su predstavljeni rezultati fenoloških posmatranja evropskog ariša na dvije lokacije. Proučavani su prirodni podmladak i samonikli primjerci evropskog ariša na zaštićenoj teritoriji «Nikolskaya Lesnaya Dacha» (severoistočni dio Moskovske regije), kao i aleja ariša zasađena 2005. godine na teritoriji Moskovskog državnog tehničkog univerziteta Bauman (centralni dio Moskovske regije). Posmatranja se kontinuirano sprovode od proljeća 2024. godine do danas, kombinacijom opšteprihvaćenih metoda. Na osnovu rezultata istraživanja u prvoj vegetacionoj sezoni, sastavljen je fenološki spektar za svaku lokaciju. Utvrđeno je da se evropski ariš uspješno prilagodio uslovima introdukcije i može se preporučiti za gajenje u šumama i parkovima Moskovske regije. Primjećeno je prisustvo zimzelenih iglica kod samoniklih ariša koje prezimljavaju pod snijegom. Radi potvrde dobijenih rezultata, posmatranja na ovim lokacijama će se nastaviti i narednih godina. Cilj ovog rada je procjena uspješnosti adaptacije evropskog ariša na uslove introdukcije (u centralnom i sjeveroistočnom dijelu Moskovske regije) proučavanjem njegovog fenološkog razvoja. Ova istraživanja su trenutno posebno relevantna, jer mogu poslužiti kao naučna osnova za uključivanje ariša u zaštitne šume Moskovske regije. Odavno je dokazano da čiste četinarske kulture imaju povećan rizik od požara, dok uvođenje ariša može smanjiti taj rizik bez gubitka vrijednosti zasada. Ariš je takođe vrijedna vrsta za urbano zelenilo jer zadržava dekorativne osobine veći dio godine i oslobađa fitoncide koji povoljno utiču na ljudsko zdravlje.

Ključne reči: evropski ariš, *Larix decidua* Mill., introdukcija, fenologija, Moskovska regija