Ecophysiological study of Siberian larch (*Larix sibirica* LDB.) seedlings planted in the degraded areas of the green zone in Ulaanbaatar

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INTRODUCTION

Siberian larch (*Larix sibirica* Ldb.) occupies about 60% of the forest reserve area of Mongolia, and 55.6% (85,167 ha) of larch forests growing in the green zone forest reserve in the capital Ulaanbaatar. The larch forest in the green zone has the importance of directly affecting the environment and health and safety of the population living in the capital Ulaanbaatar. Khandgait estuary forest is a mixed taiga forest with cedar, pine, and birch dominated by larch. A high-intensity fire broke out in the eastern part of the forest 2012, burning the entire forest and 0-10 cm soil layers. Yargait is a taiga forest with cedar, pine, and birch. The eastern part of the forest was attacked by harmful insects in 2004, and in 2010, vertical dead trees were cutting. In the spring of 2023, afforestation with larch seedlings was carried out in the area affected by fire and felling, and samples were collected in the middle of July during the most active period of plant growth to evaluate the adaptability of the seedlings. The study aimed to determine the ecophysiological status of seedlings planted in degraded areas after severe fire damage and logging.

MATERIALS AND METHODS

Study sites. The research was carried out in the forest of Khandgait (48°3'20.29"N; 106°56'56.20" E) and Yargait (48°2'20.51"N; 106°52'25.73"E) in the green zone of Ulaanbaatar city.

Experimental design. In the sample areas selected for the study, fires, and cuttings were not carried out, and the location of the edge of the forest is included. Samples are young trees regrown in degraded areas (the height of young trees is up to 20 cm); It was collected from seedlings (0-20 cm) of the afforestation area (Plot size 20x30 m; number of seedlings transplanted 500 p.). Profit was determined randomly, and measurements were performed on 18 trees from 2 sample plots (3 replicates × 18 trees × 2 plots).

Measurements. Afforestation was carried out in the spring of 2023, and the ecophysiological measurements of seedlings were conducted in July. For assessing the adaptability of seedlings, the efficiency of photosynthesis was calculated by measuring the fluorescence of needles (between 08:00 AM and 11:00 AM), and the water use efficiency of the seedlings was measured from the water potential of the stems (06:00 AM and 12:00 PM). We evaluated the state of the water potential of the stem of the native forest and understory trees, and the drought tolerance of the afforested seedlings was evaluated.

Statistic analysis. The SAS version 9.4 software package (SAS Institute Inc. 2014) was used to analyze the data with one-way analysis of variance (ANOVA) and Duncan's multiple range test was used for multiple comparisons.

RESULTS AND CONCLUSIONS

Chlorophyll fluorescence. According to the results of the ecophysiological measurements, the fluorescence measurements of the larch in the afforested area were similar to the (Fv/Fm 0.79) fluorescence state of the larch in the native forest trees (Fv/Fm 0.77-0.80) (Table 2; Figure 1-2).

Table 2. Chlorophyll fluorescence parameters of sample sites and sample trees

	F_0	F_m	F_v	F_v/F_m	PI
Khandgait forest					
Native forest	388.0±41.69	1660.55±174.17	1272.5±147.0	0.77±0.014	1.53±0.25
Young tree	403.4±47.27	1715.0±197.5	1311.57±166.79	0.77±0.02	1.87±0.29
Seedlings	503.12±44.22	2415.7±184.74	1912.6±156.0	0.79±0.01	1.66±0.27
Yargait forest					
Native forest	500.86 ± 47.27	2520.0±197.50	2019.14±166.78	0.80±0.016	2.45±0.29
Young tree	434.12 ± 44.22	2339.6±184.74	1905.5±156.01	0.81±0.015	2.68±0.27
Seedlings	450.0 ± 62.54	2158.25±261.27	1708.2±220.64	0.79±0.021	2.36±0.38

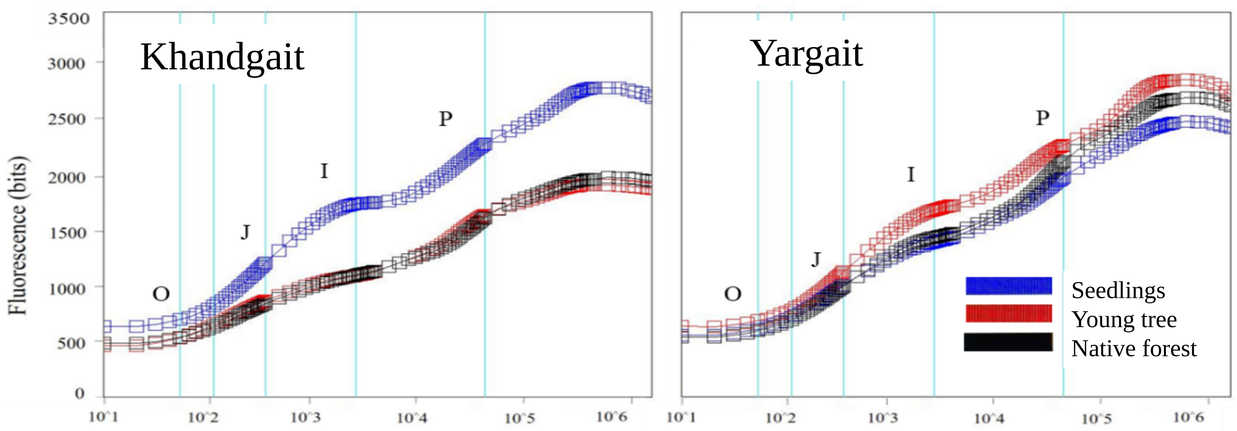

Figure 1. OJIP value of chlorophyll fluorescence of sample sites and sample trees

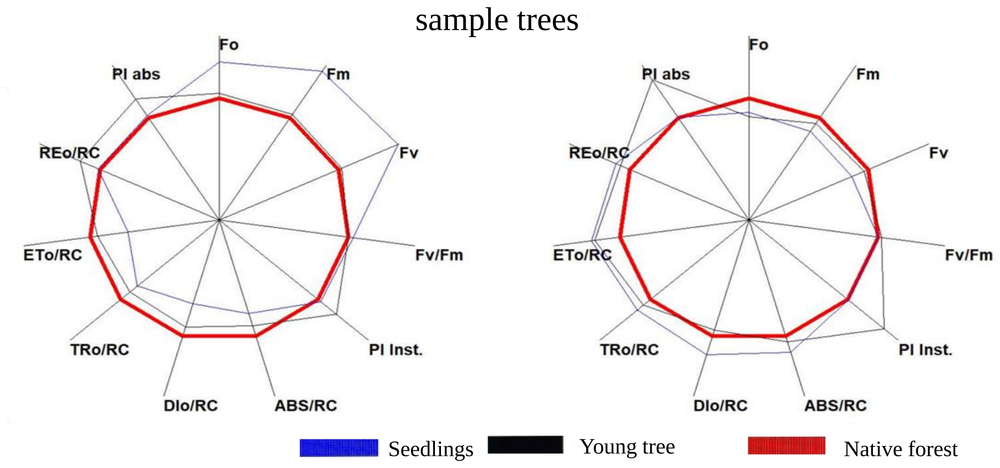

Figure 2. Photochemical measurements of chlorophyll fluorescence from sample sites and sample trees

Stems water potential. In addition, stem water potential measurement shows no difference between the original forest (-1.49±0.18 MPa), young trees (-1.27±0.25 MPa), seedlings (-1.64±0.25 MPa) or sample trees (*df=6; p=0.5*), however, it differed between sample sites (*df=2; p=0.002*) (Table 3-4).

Table 3. Measurement of stem water potential (mean ± standard error)

Measure/Sites	Water potential, (φ) Mpa		Soil moisture content, (%)	
	Predawn (06:00 AM)	Midday (12:00 PM)	Predawn (06:00 AM)	Midday (12:00 PM)
Khandgait forest				
Native forest	-1.16 ± 0.25	-1.53 ± 0.14	23.35 ± 3.59	14.26 ± 2.27
Young tree	-1.50 ± 0.25	-1.07 ± 0.24	20.10 ± 2.94	14.83 ± 2.94
Seedlings	-1.28 ± 0.25	-0.96 ± 0.24	33.56 ± 2.94	29.17 ± 2.94
Yargait forest				
Native forest	-1.99 ± 0.17	-1.27 ± 0.17	15.78 ± 2.08	14.52 ± 2.08
Young tree	-1.43 ± 0.24	-1.08 ± 0.24	24.00 ± 3.59	21.45 ± 3.60
Seedlings	-1.66 ± 0.25	-2.65 ± 0.24	16.77 ± 2.94	24.47 ± 2.94

Table 4. Analysis of Variance in Tree Stem Water Potential Measurements

Variables	DF	MS	F value
Water potential, (φ) Mpa	1	1.974	10.680***
Soil moisture content, (%)	1	82.970	3.203***

Picture 1. Measurements of chlorophyll fluorescence, water potential and soil moisture content of sample sites and sample trees

This finding indicated that the juvenile trees have higher adaptability to the environment and the survival of the seedlings is relatively high. Afforested seedlings have a low water stress exposure, indicating their high tolerance to drought and adaptability.

Acknowledgement

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