

Research on an effective artificial regeneration method for selected commercially important coniferous tree species on a large sanitation cut site situated in the Javorníky Mts., Western Carpathians

MARTIN BELKO^{1*}, ANNA TUČEKOVÁ¹, ROMAN LONGAUER^{1,2}, VALÉRIA LONGAUEROVÁ¹, VLADIMÍR MAČEJOVSKÝ¹, IVAN HORVÁT¹

¹Forest Research Institute, National Forest Centre, Zvolen, Slovakia

²Faculty of Forestry and Wood Technology, Mendel University in Brno, Brno, Czech Republic

*Corresponding author: martin.belko@nlcsk.org

Electronic Supplementary Material (ESM)

The authors are fully responsible for both the content and the formal aspects of the Electronic Supplementary Material. No editorial adjustments were made.

<https://doi.org/10.17221/1/2024-JFS>

Table S1. Cost-effectiveness of the establishment of four commercially important coniferous tree species through different artificial regeneration methods on the Husárik trial plot, Javorníky Mts., Western Carpathians

Artificial regeneration method		Reproductive material		Manual planting (transplants)/ seeding (seeds)		Post planting care				Successfully established plantation status confirmation	Total costs (EUR)
		(transplants/ seeds)		(seeds) on spots		manual weed control on spots		individual protection against game			
		number	costs (EUR)	number	costs (EUR)	number	costs (EUR)	number	costs (EUR)		
Norway spruce											
BR	normative	1 000	315	1 000	380	1 000	55	1 000	30	confirmed (5 years)	2 800 ¹
	real per ha	2 500	788	2 500	950	2 500	687	2 500	375		
CON	normative	1 000	486	1 000	380	1 000	55	1 000	30	confirmed (6 years)	3 096
	real per ha	2 250	1 094	2 250	855	2 250	743	2 250	404		
DS	normative	1 000	15	1 000	380	1 000	55	1 000	30	failed (8 years)	2 800
	real per ha	10 000	150	2 500	950	2 500	1 100	2 500	600		
VCS	normative	1 000	15	1 000	450	1 000	55	1 000	30	confirmed (8 years)	2 975 ²
	real per ha	10 000	150	2 500	1 125	2 500	1 100	2 500	600		
European larch											
BR	normative	1 000	315	1 000	380	1 000	55	1 000	30	confirmed (3 years)	2 375
	real per ha	2 500	788	2 500	950	2 500	412	2 500	225		
CON	normative	1 000	486	1 000	380	1 000	55	1 000	30	confirmed (3 years)	2 522
	real per ha	2 250	1 094	2 250	855	2 250	370	2 250	203		
DS	normative	1 000	18	1 000	380	1 000	55	1 000	30	confirmed (5 years)	2 372
	real per ha	20 000	360	2 500	950	2 500	688	2 500	375		
VCS	normative	1 000	18	1 000	450	1 000	55	1 000	30	confirmed (5 years)	2 548
	real per ha	20 000	360	2 250	1 125	2 250	688	2 250	375		
Silver fir											
BR	normative	1 000	475	1 000	380	1 000	55	1 000	30	confirmed (6 years)	4 980
	real per ha	4 000	1 900	4 000	1 520	4 000	840	4 000	720		
CON	normative	1 000	811	1 000	380	1 000	55	1 000	30	failed (9 years)	7 041
	real per ha	3 600	2 920	3 600	1 368	3 600	1 782	3 600	971		
DS	normative	1 000	25	1 000	380	1 000	55	1 000	30	failed (9 years)	5 380
	real per ha	32 000	800	4 000	1 520	4 000	1 980	4 000	1 080		
VCS	normative	1 000	25	1 000	450	1 000	55	1 000	30	failed (9 years)	5 660
	real per ha	32 000	800	4 000	1 800	4 000	1 980	4 000	1 080		
Douglas fir											
BR	normative	1 000	475	1 000	380	1 000	55	1 000	30	failed (7 years)	3 538
	real per ha	2 500	1 188	2 500	950	2 500	875	2 500	525		
CON	normative	1 000	600	1 000	380	1 000	55	1 000	30	failed (7 years)	3 465
	real per ha	2 250	1 350	2 250	855	2 250	788	2 250	472		
DS	normative	1 000	144	1 000	380	1 000	55	1 000	30	failed (9 years)	4 663
	real per ha	12 500	1 800	2 500	950	2 500	1 238	2 500	675		
VCS	normative	1 000	144	1 000	450	1 000	55	1 000	30	failed (9 years)	4 838
	real per ha	12 500	1 800	2 500	1 125	2 500	1 238	2 500	675		

Depending on the fulfilment of the stem height criteria reported for a successfully established plantation in Notice No. 453/2006 of the Ministry of Agriculture of the Slovak Republic, total costs are related to the moment when the average

height of individuals exceeds this threshold height. Issuance of the successfully established plantation status confirmation is considered according to the accomplishment of further criteria including average survival and level of damage. For CON transplants, a lower number per ha was considered (STN 48 2210 Silviculture. Artificial regeneration of the forest and post planting care interventions). Prices used within the calculation of costs were derived from publicly available price lists of state-owned forestry subjects valid in 2023 (Lesy SR š.p., O.Z. Semenoles, Vojenské lesy a majetky SR, š.p.);

BR – bareroot transplants; CON – container transplants; DS – direct seeding; VCS – vegetative cell seeding using seed shelters;

¹ example of calculation of total costs required for the establishment of 1 ha of a successfully established plantation of BR spruce on the Husárik trial plot, Javorníky Mts., Slovakia:

[normative number of transplants per ha (2 500 pcs) × price per 1 000 transplants (EUR 315)] + [normative number of planted transplants per ha (2 500 pcs) × costs per 1 000 planted transplants (EUR 380)] + [normative number of planted transplants per ha (2 500 pcs) × weed control costs per 1 000 planted transplants* (EUR 55) × number of growing seasons until fulfilment of successfully established plantation criteria** (5 years***)] + [normative number of planted transplants per ha (2 500 pcs) × protection against game costs per 1 000 planted transplants (EUR 30) × number of growing seasons until the fulfilment of successfully established plantation criteria* (5 years)] = EUR 2 800;

² example of calculation of total costs required for the establishment of 1 ha of a successfully established plantation of VCS spruce on the Husárik trial plot, Javorníky Mts., Slovakia:

[number of seeding spots (normative number of individuals) per ha (2 500 pcs) × number of seeded seeds per 1 seeding spot (4 seeds) × price of 1 000 seeds (EUR 15)] + [number of seeding spots per ha (2 500 pcs) × costs per 1 000 established seeding spots (EUR 450)] + [number of seeding spots per ha (2 500 pcs) × weed control costs per 1000 established seeding spots* (EUR 55) × number of years until fulfilment of successfully established plantation** (8 years***)] + [number of seeding spots per ha (2 500 pcs) × protection against game costs per 1 000 established seeding spots (EUR 30) × number of years until fulfilment of successfully established plantation criteria* (8 years)] = EUR 2 975;

* due to the experimental character of the trial plot, all planted/seeded spots had to be weeded and checked for individual protection against game;

** the term 'successfully established plantation' refers to a legal act (Notice No. 453/2006); it includes a minimal proportion of undamaged living individuals as well as their minimal height of aboveground part derived from the height of competing vegetation at the site; a successfully established plantation does not need further post-planting care and is able to grow without any additional post-planting care interventions;

*** reported number of years refers to the number of years required by the assessed cohort of individuals to meet the criteria of a successfully established plantation (demonstrated in the study): survival ≥ 50%; proportion of damaged individuals ≤ 50%; height of aboveground part ≥ 120 cm