

WP5 Forest Operations

Task 5.4 Planting with a wood fiber-based hydrogel

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Introduction

For tree growth, particularly for reforestation of degraded forest land, the precipitation during the vegetation period is essential. In the case study region (CSR) Thuringia, the mean precipitation in April significantly decreased (-28%) within the period 1991-2020 against the long-term average of 1961-1990 (TMIL 2023).

The developed wood fiber-based hydrogel (SoilCond; compare UTR, THRO) supports tree growth after planting. The SoilCond is biodegradable without leaving any residues in forest, and therefore a high level of interest was expressed by both, the state forest administration of Thuringia (ThüringenForst) and private forest companies (e.g., Wald+).



Fig 1: Planted Douglas fir in Heldburg

From lab to practice, we performed four planting experiments to better understand potential applications and to identify suitable solution to implement the provision of SoilCond in planting processes (Fig 1).

Methodology

#1 Jessen, Germany, 2022

This planting experiment aimed to understand the work performance during planting with SoilCond in liquid or dry matter. In total 300 trees were planted and tree growth was analyzed for two growing periods to identify tree growth against the doses of SoilCond.

#2 Heldburg, Germany, 2023

The study focused on workers performance during manual planting with the provision of SoilCond in form of granules or tabs. We planted 189 bare-root Douglas firs (*Pseudotsuga menziesii*) in seven variants (Tab 1). The planting was carried out by two professional forest worker in a one-person and two-persons mode, using a hollow spade. The work study was performed by two observes with manual recording of work elements (Björheden et al. 1995).

Variation	Hydrogel	Application	Method
V1	150g Xanthan gum –Wood fiber	Granulate	2 workers
V2	75g Xanthan gum – wood fiber	Granulate	1 worker
V3	BeGrow Boost M	Tap	2 workers
V4	Zero	No	1 worker
V5	40g Terra Cottem	Granulate	2 workers
V6	150g Gelatine – Wood fiber	Granulate	/
V7	150g Gelatine – Sheep wool	Tap	1 worker

Tab 1: Description of studied variants in Heldburg, Germany

#3 Gotha, Germany, 2024

Together with ThüringenForst a work study with ten forest worker was performed on experimental sites in the region of Gotha. Two experienced observer recorded 200 repetitions for the elements 'site preparation', 'hole digging', 'SoilCond application', 'planting', and 'watering'. Again, the planting was done completely manually. We currently analyze the data.

#4 Salem, Germany, 2024

This experiment aimed to better understand semi-mechanized planting with SoilCond, and to compare those with manual planting operations in aspects of time consumption and costs. The work study was performed during spring planting of 90 Douglas fir trees (*Pseudotsuga menziesii*). The planting hole was opened by a rotating spade (Krümler) mounted on the boom of a forwarder with adding of the SoilCond in parallel. Planting was manual work.

Results

Planting in #2 Heldburg and the work study followed a systematic design (Fig 2).

For the one-person mode the mean time consumption was lowest for Var 7 (0:47 min \pm 0:10 min) with the provision of SoilCond in form of a tab (Fig 3). However, the time consumption for applying no

SoilCond was only slightly higher (Var 4: mean 0:53 min \pm 0:11 min). The provision of the granulate (Var 1) was most time consuming (mean 1:09 min \pm 0:12 min). The time for 'walking' was similar in all cases with a mean of 0:14 min \pm 0:09 min. The average time saving of the two-person mode against the one-person mode was 39%, resp. 0:26 min applying a granulate (Var 1 vs. Var 2) and 36%, resp. 0:16 min applying a tab (Var 3 vs. Var 7). Also in the two-person mode the application of a SoilCond granulate was most time consuming (Fig 4).

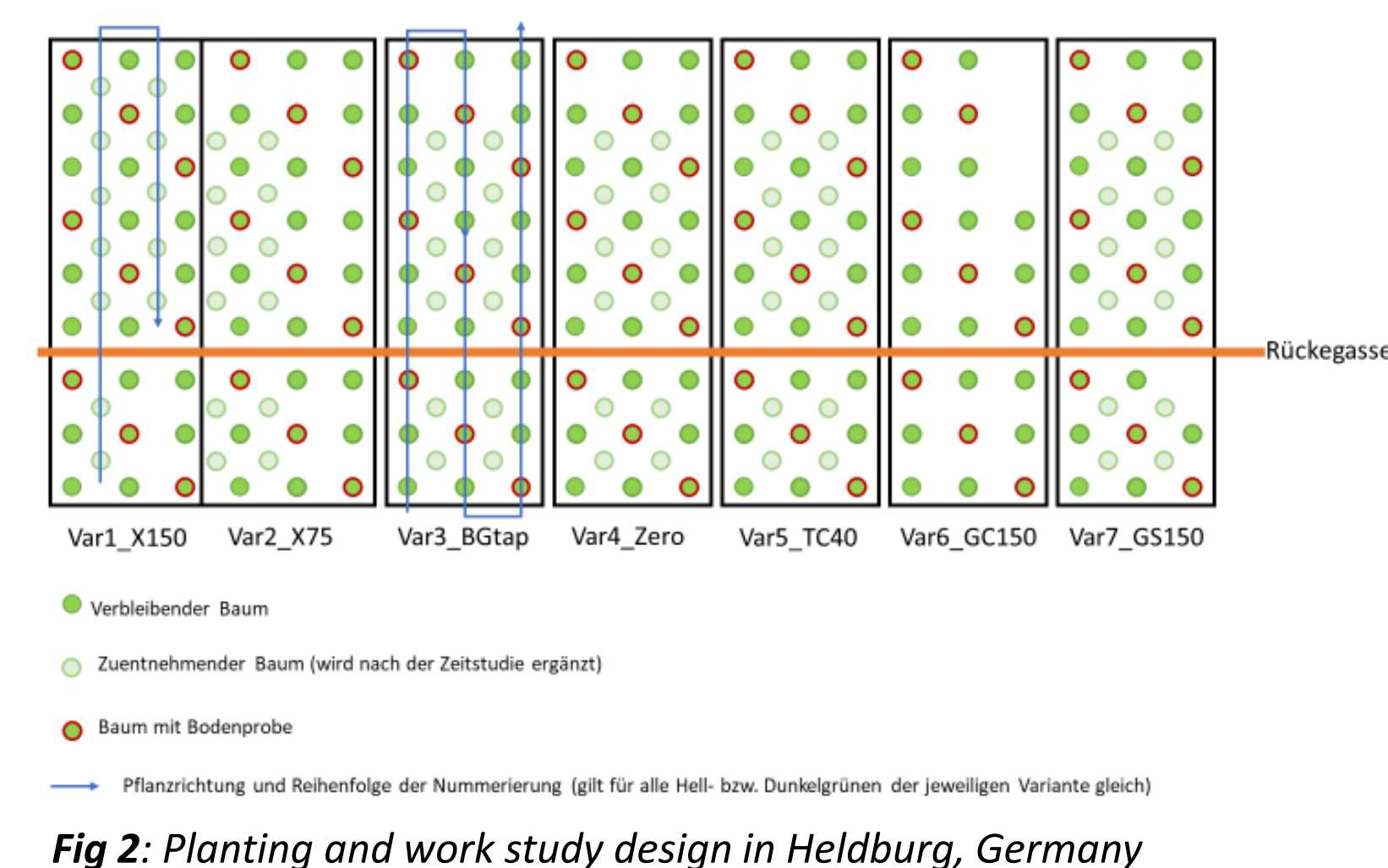


Fig 2: Planting and work study design in Heldburg, Germany

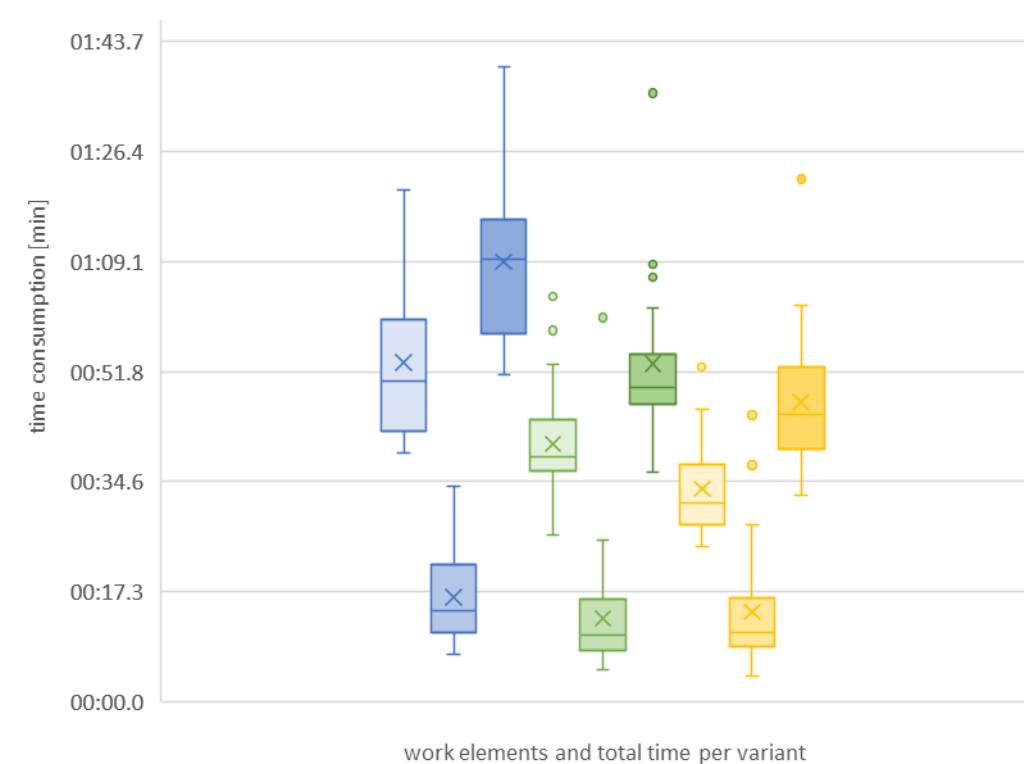


Fig 3: Time consumption of work elements and in total

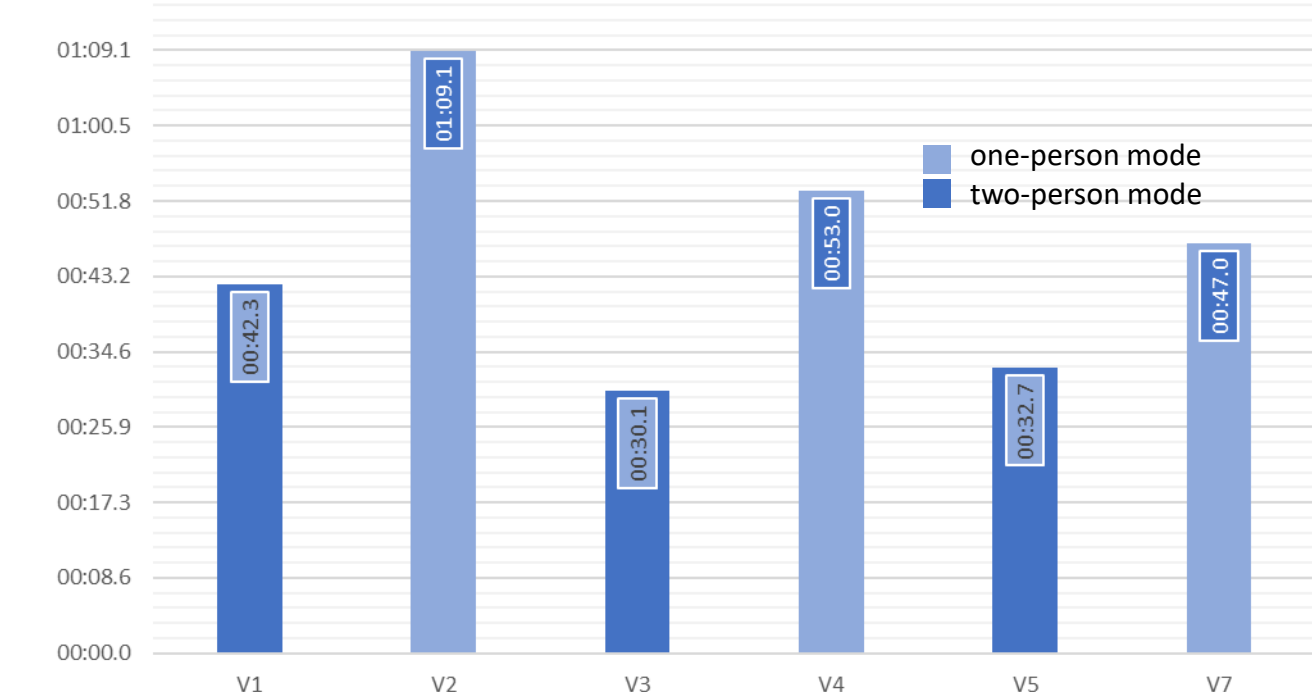


Fig 4: Total time consumption of the variants

Conclusions

The difference in time consumption between planting in one-person and two-person mode is not large enough to make it worthwhile in terms of time and personnel effort to favor the two-person mode. The one-person mode would therefore be recommended from an economic perspective. However, ergonomic stress was not analyzed during this study, but should be taken into account.

Applying the SoilCond in any form doesn't seem to take much more time against the conventional planting in the one-person mode. The application of the SoilCond as a tap is the easiest and also fastest application method during manual planting. To activate the SoilCond raining days following the planting or manual watering is required.

In all planting experiments stakeholders, particularly forest owners, forest managers and forest worker were included. Additionally, the first planting experiment was presented at the KWF Thementage (national fair) and results were discussed with fair visitors. We received a very positive feedback and a high interest in this topic.

Acknowledgements

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