Mendel University in Brno
Czech Society of Landscape Engineers – ČSSI, z.s.

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MENDEL UNIVERSITY IN BRNO

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Department of Landscape Management
Faculty of Forestry and Wood Technology
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of doc. Ing. Tomáš Vrška, Dr., the Director of Training Forest Enterprise Masaryk Forest Křtiny, Mendel University in Brno,
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Contents

INNOVATIVE TECHNOLOGY OF SAPLINGS PLANTING FOR INCREASE TOURISM POTENTIAL OF THE LANDSCAPE

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Abstract

The saplings extractor is intended primarily for replanting all types of seedling forest trees included a bale of soil without disturbing the root system. Trees growing along roads or already grown to a certain extent trees in the landscape are often need to be transplanted due to landscaping or urban planning. These trees can be used, for example, in popular tourist localities, where they can speed up the regeneration of the landscape and make visitors' stay more pleasant. However, this activities shouldn't be provided only manually, but some advanced technologies have to be used. The goal of this paper is presenting a new technology for mechanized planting using the production potential of the seedling trees. The principle of the saplings extractor lies in excavating a pit at the site that will be the subject of tree replanting, and then transplanting the pre-lifted up seedling forest tree into the prepared excavated pit. The last phase is to backfill the pit all around with soil from the excavated pit after the sapling was picked up. This paper emphasise the economic advantages of new technology and provides the saplings planting solutions in the form of landscaping, road tree rows or ornamental trees in an urbanized environment.

Key words: forest planting, forest regeneration, landscape regeneration, sapling extractor, tree transplanting

Introduction

The goal of most national economies is the production of forest resources through the intensive silviculture methods in connection with growing consumption and wood demand in the world. (Shestibratov et al. 2018). It follows, that forest regeneration is an essential part of the forestry. After logging, the stand reforestation is complicated by many factors, such as competitive vegetation, drought or frost (Grossnickle 2000). Additionally, environmental factors can affect the forest regeneration include soil quality, weed presence or invasive species that may discontinue the natural regeneration process or cause insufficient seed dispersal (Rey Benayas et al. 2008*).* For this reason, it is necessary to carry out an appropriate site preparation that might improve the stand conditions and thus increase the survival and growth of the planted seedlings within an artificial regeneration (Wallertz et al. 2018; Staněk et al. 2022). However, this process brings increased financial costs. Therefore, the main condition to gain a successful cultivation of forest plantation is the correct area selection as well as the planting stock variety and species selection, which is optimal in specific climatic conditions (Morkovina et al. 2019).

In order to reduce the economic costs of forest regeneration, the so-called natural regeneration is also used. The main advantage of natural regeneration compared to artificial regeneration is reduced implementation costs substantially (Cruz-Alonso et al. 2019). This is primarily about the financial costs spending on purchase of the forest seedlings.

The aforementioned issues relating to artificial and natural regeneration might be avoided when using the saplings extractor technology.

Materials and methods

The decisive factors affecting the economic indicators of forest regeneration are mainly: price of the purchased planting stock; number of workers needed; physical demand and time consumption of relating labors; saplings survival; the future forest stand care and protection. Within the research, the forest regeneration and forest plantation care economic costs were compared between the saplings extractor and manual slit planting using a hoe. The comparison of both methods lies primarly in the time consumption, financial costs of planting stock and labor activities related to the site reforestation. Due to the fact, that the extractor transplants saplings with a height of 1.5 to 2.8 m, their survival is considerably high. For this reason, planting in a square spacing 3 x 3 m is sufficient, i.e. approx. 1,200 pieces of saplings per hectare. Under optimal conditions, the planting performance is approx. 10 saplings per hour, when the seedling forest is located within a reach of 50 m to 100 m. Therefore, 80 pieces of saplings might be replanted during one work shift.

Results

Table 1 presents the reforestation costs and forest plantation care until the stand provision on area of 1 ha by slit planting with use a manual hoe.

Tab. 1: Economic evaluation of forest regeneration using a manual axe-hoe

Type of action	The classic method technology - 1 ha	Amount [pcs]	Price [CZK]	Total [CZK]
Material purchase	Min. planting stock (decree no. 456/2021 Sb.)	7 000 pcs	10	70 000
Planting	Manual reforestation with a hoe	7 000 pcs	25	175 000
Weeding	Mechanized weeding (2x a year)	6 yrs	8 000	48 000
Chemical protection	Repellent + work, browsing protection, autumn	4 yrs	0,7	19 600
Protection of game	Game-proof fence construction	1 ha	9 000	9 000
Reiterating care	New stock purchase (survival 75 % on area)	1 750 pcs	10	17 500
	Reforestation work	1 750 pcs	25	43 750
	Reduction of time delaying production	4 yrs	1 500	6 000
Total costs				**382 850**

Table 2 presents the forest regeneration costs on area of 1 ha using the saplings exctractor that transplants taller trees lifted out from natural rejuvenation within the reach of the seedling forest site into a square spacing pattern 3 x 3 m.

Tab. 2: Economic evaluation of forest regeneration using the saplings extractor in 3 x 3m square spacing

Type of action	The saplings extractor technology - 1 ha	Amount [pcs]	Price [CZK]	Total [CZK]
Extraction Transport	Tractor performance with adapter - 10 pcs/hour - fuel etc.	1 200	60	72 000
	Planting 3 x 3 m square spacing –> 1,200 pcs/ha - operator	1 200	30	36 000
Planting	Ancillary works - adapter control, surface treatment	1 200	25	30 000
Total costs				**138 000**

Table 3 presents the forest regeneration costs on area of 1 ha using the saplings exctractor that transplants smaller trees lifted out from natural rejuvenation within the reach of the seedling forest site into a square spacing pattern 2 x 2 m.

Tab. 3: Economic evaluation of forest regeneration using the saplings extractor in 2 x 2 m square spacing

Type of action	The saplings extractor technology - 1 ha	Amount [pcs]	Price [CZK]	Total [CZK]
Extraction Transport	Tractor performance with adapter - 10 pcs/hour - fuel etc.	2 500	60	150 000
	Planting 2 x 2 m square spacing –> 2,500 pcs/ha - operator	2 500	30	75 000
Planting	Ancillary works - adapter control, surface treatment	2 500	25	62 500
Total costs				**287 500**

The obtained results show that the saplings extractor utilization represents significantly lower costs than "conventional" forest regeneration, that comprises i.e. the planting stock purchase, the weed protection, the game damage protection, etc. Specifically, the reforestation financial costs using the saplings extractor in a 3 x 3 m square spacing pattern compared to the default manual reforestation represents a saving of CZK 244,850. In case of the saplings extractor usage in a 2 x 2 m square spacing pattern, there is a decrease in financial costs compared to manual reforestation by CZK 98,080. When using a new technology, the financial amount difference of saplings planting between a 2 x 2 m and a 3 x 3 m square spacing pattern is CZK 149,500.

The results show that a significant cost item is the planting stock purchase. With help of the saplings extractor, only required tree species are selected and transplanted to the site. Therefore, there is no need to invest a financial means further.

Conclusion and Discussion

The economic benefits using the presented technology consist in:

- utilization of forest species seedlings, i.e. no acquisition costs for planting stock material. This represents a significant expenditure of financial sources (Bullock et al 2011) and the high costs of afforestation or forest regeneration will reduce the overall profitability as well (Serrano-León et al. 2021);
- minimum number of employees - operator with + services, max. 2 persons;
- almost 95% survival of planted saplings
- no further investment is required within the stands care (removed costs of weed disposal; reduction of the costs of repeated forest regeneration; reduction of the time to ensure a forest plantation by an average of 2 years, thereby reducing costs of the game damage protection (game-proof fence maintenance, possibly repellents care); reduction of time, an average of 2 years, when the forest plot is effectively taken out of production due to the failure of afforestation or the slow growth. Grossnickle and El-Kassaby (2016) state that larger seedlings have a better ability to cope with competing vegetation and insect damage than smaller ones.

  The non-economic project benefits may be identified indirectly, when the saplings extractor is used on linear constructions - along power lines, railway transport routes, roads, in landscape, urban development, etc., where it is necessary to pick up sapling even in inaccessible terrain and then ensure the planting of clearings or avenues. Last but not least, transplanted saplings in this way also contribute to mitigate the effects of climate changes simultaneously supporting the function of the environment for storing carbon and preserving biodiversity (Staněk et al. 2020; Matos et al. 2020).

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Souhrn
Vyzvedávač odrostků je určen primárně k přesazování všech druhů náletových dřevin s balem zeminy bez narušení kořenového systému. Případně pro vysazování dřevin s balem zeminy, které byly vypěstovány např. v lesní školce. Náletové lesní dřeviny, ale i pouliční stromky, stromky podél silničních komunikací či stromky v krajině, které jsou již do určité míry vzrostlé, je zapotřebí z důvodu terénních úprav, rozvoje životního prostředí či urbanismu, často přesadit. Tuto činnost však nelze provádět pouze ručně, ale je nutno použít nějaké pokročilé technologie. Cílem tohoto příspěvku je představit nový vyzvedávač odrostků dřevin pro mechanizovanou výsadbu, který umožňuje využití produkčního potenciálu náletových dřevin. Princip vyzvedávače spočívá ve vyhloubení jámy v půdě na lokalitě, která bude předmětem vysazení dřeviny, a následném přesazení vyzvednuté náletové dřeviny do připravené vyhloubené jámy. Finálním krokem je zasypání jámy po vyzvednuté dřevině zeminou z vyhloubené jámy. Tento příspěvek zdůrazňuje ekonomické výhody při použití nové technologie během vysazováním odrostků v lesním hospodářství, ale i při úpravách krajiny, silničních stromořadí či okrasných dřevin v urbanizovaném prostředí.

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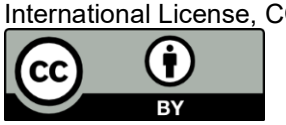

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