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RESEARCH IN THE MECHANIZATION OF BLACK LOCUST RENEWAL AND PLANTING

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ABSTRACT

Nowadays, the black locust (Robinia pseudoacacia) is the most current and the most widely used tree species in Hungary. Due to its penetration and the wide variety of application it's worth to examine the different mechanization options of the reforestation technologies and their costs.
We provided our research in the area of Nyírerdő Nyírségi Erdészeti Zrt.
According to the tests it can be said, that the cost of the reforestations with root ripping is the most favourable and the reforestation or regeneration with planting costs the most. The disadvantage of the regeneration with root ripping is, that after its multiple application it can be observed the significantly degradation of the assortment composition and of the tree utilization income.

Keywords: black locust, mechanization, specific cost, Nyírség

1. INTRODUCTION

The black locust (Robinia pseudoacacia) is in Hungary the most current and the most widely used tree species in Hungary, especially in the Great Hungarian Plain. More than 24% of all forest area is covered by black locust, this means 451 771,95 hectares and 50 829 689,00 m3 tree [1]. The most prominent black locust-producing districts are the Nyírség, Cserhát, hills of Gödöllő, sand dunes of Duna-Tisza köz, ridge of Vas-Zala, and the sandy area of the Little Hungarian Plain. Among them, the Nyírség, the Duna-Tisza köze and the Northern Part of Somogy have high quality stands.
The natural spread of the black locust in the US is between 43-35 degrees. The black locust was brought to Hungary around 1710. Initially, it was planted as a park tree and a pathway that surrounds roads. For the purpose of afforestation, the military treasury used it for the first time in 1750 around the fortress of Komárom-Herkály. At the beginning of the 1800s, in the Great Plain they started planting it to fasten the quicksand, then they also created shelter-belts from black locust. Its mass spread in Hungary began in the mid-1800s.
Due to the law, in those areas, which are unsuitable for agricultural operations, 38000 ha black locust forest was planted [2] [3].
Its rapid spread in our country is due to its good adaptation capability, its common and plentiful seed crop, which is the bottom of the seedling cultivation, and due to its granulation capability, and last but not least, due to its large wood yields.
The good physical conditions and the extreme durability of the black locust's wood make it possible for the sawmill industry, furniture industry and for the carpentry industry the widespread usability. The barrel production finds its raw material important, because its wood isn't permeable to water in case of cutting direction either. It's widely used in land-and water biulding, it's a long lasting fencing panel, vine pole, vine stake. Black locust is used in the production of pulp, fibreboard and chipboard. Recently, laminated-glued holders are made of it. Half the weight of the exploited black locust serves energetic purposes, so it will became firewood. [4].
Due to its widespread and multiple use it's worth to examine the mechanization possibilities of the different reforestation technologies, and their costs.

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2. THE TECHNOLOGIES OF THE BLACK LOCUST'S PRODUCTION

The renovation of forest areas covered by black locust in domestic practice can basically be done in two ways. In one case, with root tearing, in the other case with full soil preparation after seeding, with planting or with cuttings.

In the latter case, before the propagation material gets into the soil, the following operations have to be done in the area of the depleted forest:

- site clearing,
- stumping,
- stump-pushing,
- flatwork,
- trenching+ smoothing,
- uprooting,
- soil crumbling.

In case of the **site clearing**-which can be done manually or with machines- the branches, bark, pieces of wood will be removed from the area. In case of manual site clearing the gathered felling residue will be put on a stump, to minimize the loss of space, or we pull them together in strips and in heaps, which will stay in that area or will be cut. In case of mechanical site clearing, with the help of a site clearer powered by toothed cutter we will put the slash together either to the edge of the area or into the strips. It's a more prefered solution to use hay horizontal shaft slash chopper, which smash the along the area scattered piece of woods, branches into small pieces and leave them on the area. These small pieces won't bother the other procedures and will serve as a nutrient with time.

In case of soil cultivation the **stumping** essential, because the ploughing and the trenching can't be done because of the stumps in the soil. The stumping is really costly but it's able to reduplicate the afforestation costs. The removal of the stumps will be done by means of machine tools designed for this purpose.

During the **stump-pushing** in the area after the stumping the scattered stumps will be sorted in row. There's no need for this procedure in case of clutching accent stump puller, because the picked-up stumps will be composed in stump –rows. We usually do the procedure with stump-pusher or with bulldozer.

In case the stumps of the area will be sold, this operation can be postponed as well, because this timet he stumps will be chipped with special chippers. At this time there will be no stump- rows.

For the uninterrupted continuation of the afforestation works the **flatwork** is essential. Those operations belong here, where we make the area passable for the power machines. As a result of the stumping generated pits will be bury and we smooth the hillocks. The operation of plaining is also an essential process in sand areas, where the dunes should be transformed in such way, that the its slope will be favourable for the machines. We can do the flatwork with blades attached to the tool-machines or we can do it with towed graders.

For **trenching**, the ground is rotated to a depth of 50-70 cm. This operation is carried out by rippers. In many cases with the deep rotation the smoothing is also done. After the rotation the area has not an appropriate quality for the planting or for the sowing, that's why there's a need for smoothing during which we try to smooth the jagged soil surface as smoothly as possible.

On the stumped area, after turning to the surface of the soil or to the roots near the surface have to be removed for the future machine planting and tilling. The **root removal** can be done in two ways. In one case it can be done manually and it has to be done immediately after the turning soil cultivation, in the other case it has to be done mechanically. In the latter case it can be done later. The operation is carried out by a root rake fixed on a power machine. The collected roots have to be removed from the area. In case of doing the stumping not with stump extraction , but with the help of stump driller or stump chipper, then before rotating the area, the root-raking has to be applied , that the larger roots left in the soil don't damage the plough.

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The soil crumbling has several advantages. It should be done before planting and sowing, that the seedlings and seeds in the area can be placed in an appropriate structure soil. But it's also suitable for the reducing of weeds, because if we crumble and old weedy ploughing, then the weed will be also worked into the soil. There're currently many machines available for the soil crumbling.

The delivering of the propagating material into the soil can be done by sowing, planting or by planting cuttings.

Sowing with afforestation is preferable to planting, because the seedling numbers will be higher, which will result in faster closure of the stock and a greater natural selection. This afforestation method is closer to the natural reforestation. The sowing requires less work and cost than planting. However, its disadvantage is that in the weediness prone areas the care work has to be done several times, and because of the uncertain seed production there is not always available the right amount of propagating material. The sowing can be done manually or mechanically. The manual sowing is done in areas without partial soil preparation or soil preparation. We put 4-5 seeds into a pit made with the help of hoe, hack, grubbing hoe, and than we cover it. The mechanical sowing can be applied after complete soil preparation.

The **planting** can be also done manually or mechanically. The tools of manual planting can be the spade, hoe, hack, and the planting bar. During planting we have to take it into account the size of the seedlings, and we have to dig pits for the roots of the seedling with the appropriate depth and width. The other method is mechanical planting, which is much faster and has a lower demand of labour, and the afforestation with it is much cheaper.

The black locust has an excellent regeneration ability, especially vegetatively. We take advantage of this ability of the black locust during the **planting cuttings**. The root cutting dates back to the 1980s. Actually, this is also a kind of coppicing. The picked roots of the selected mother trees will be cut into pieces, which can be up to 10-12 cm or 2-4 cm dependig on the thickness of the root. These pieces are placed into the seed furrow in such a way that they're strictly horizontal so that the cuttings are very similar to the coppicing situation after root ripping. This wood-production technology is very rarely used [5].

The black locust is able to sprout from root or from stump as well, but the with root sucker renewed black locust has much better properties than the stump sprout. This is the basis of the reforestation technology made with **root ripping**. The ripping of the black locust's roots near to the soil surface is done by the late help of the machineries' knives.

Since the black locust is very viable and fast growing species, therefore, the nursing of the regrowth should only be carried out in justified cases. The most commonly used care technologies in the locust [6]:

- *Manual in-line hoeing:* Its essence is to free the weed competition after the interrow weeding and to loosen the soil. The operation will be mainly done manually or by hoe.
- *Shoot control:* The suppression of the in the stand undesirable stump sprouts, so that we can provide the appropriate growing space for the slowly growing root suckers. It can be done by axe, or by chain saw at an older age.
- *Cutting off to one leader:* We choose the regrowth with the most appropriate natural qualities to be the leading shoot, and the other ones will be
- *Cutting at base:* The 1 or 2 year-old seedling will be cut at base after reaching the appropriate root size, so we can achieve that the again shooted sprout specimen will grow faster, it will be straighter and will raise less stems with side branches.
- *Chemical weed control:* It's such an in-line weeding activity that we can drive back the weeds with, so that won't mean competition for the seedlings.
- *Mechanical interrow care:* During the procedure we do the interrow soil crumbling and weed control. The operation can be well mechanized, as the machines fit well in the spacing, without damaging the regrowth. The interrow care means very often the „shearing" of the weed with slash chopper.

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3. THE MACHINES FOR THE BLACK LOCUST'S REFORESTATION TECHNOLOGIES AND THEIR SPECIFIC COSTS IN THE NYÍRSÉG

We did our researches in the area of the Forestry in Nyíregyháza of the NYÍRERDŐ Zrt. We summarized the specific costs of the consecutive work phase and compared them to eachother (Table 1, Table 2, Table 3, Table 4). In addition to the specific costs, the table also lists the machines that are used for the particular work phase.

Table 1. Reforestation technology I.

Reforestation (with sowing)			
Work phase	**Power machine**	**Machinery**	**Specific costs**
Site clearing	Front-end loader	VT-02	18.000 Ft/ha
Stumping	JCB 4cx front-end loader	Special stump extraction spoon	160.000 Ft/ha
Stump-pushing	T-130	Blade	80.000 Ft/ha
Flatwork	T-130	Blade	50.000 Ft/ha
Trenching +smoothing	T-130	Ripper+disk	80.000 Ft/ha
Uprooting	T-130	Root rake	35.000 Ft/ha
Soil crumbling	T-150	Disk	10.000 Ft/ha
Sowing	MTZ 820.4	Seeder	40.000 Ft/ha
Care	MTZ 820.4	Slash chopper	10.000 Ft/ha
Total			**483.000 Ft/ha**

Table 2. Reforestation technology II.

Reforestation (with planting)			
Work phase	**Power machine**	**Machinery**	**Specific costs**
Site clearing with machine	Front-end loader	VT-02	18.000 Ft/ha
Stumping	JCB 4cx front-end loader	Special stump extraction spoon	160.000 Ft/ha
Stump-pushing	T-130	Blade	80.000 Ft/ha
Flatwork	T-130	Blade	50.000 Ft/ha
Trenching +smoothing	T-130	Ripper+disk	80.000 Ft/ha
Uprooting	T-130	Root rake	35.000 Ft/ha
Soil crumbling	T-150	Disk	10.000 Ft/ha
Planting	John Deer 2250	ERTI planting	80.000 Ft/ha
Care	MTZ 820.4	Slash chopper	10.000 Ft/ha
Total			**523.000 Ft/ha**

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Table 3. Reforestation technology III.

Reforestation (with planting cuttings)			
Work phase	**Power machine**	**Machinery**	**Specific costs**
Site clearing	Front-end loader	VT-02	18.000 Ft/ha
Stumping	JCB 4cx front-end loader	Special Stump extraction spoon	160.000 Ft/ha
Stump-pushing	T-130	Blade	80.000 Ft/ha
Flatwork	T-130	Blade	50.000 Ft/ha
Trenching +smoothing	T-130	Ripper+disk	80.000 Ft/ha
Uprooting	T-130	Root rake	35.000 Ft/ha
Soil crumbling	T-150	Disk	10.000 Ft/ha
Planting cuttings	MTZ 820.4	BDÜ-2E	50.000 Ft/ha
Care	MTZ 820.4	Slash chopper	10.000 Ft/ha
Total			**493.000 Ft/ha**

Table 4. Reforestation technology IV.

Reforestation (withh root ripping)			
Work phase	**Power machine**	**Machinery**	**Specific costs**
Site clearing	Front-end loader	VT-02	18.000 Ft/ha
Root ripping	T-150	Ripper wedge	45.000 Ft/ha
Care	MTZ 820.4	Slash chopper	10.000 Ft/ha
Total			**73.000 Ft/ha**

4. CONCLUSIONS

Based on the data it can be said, that by sowing, planting, and planting cuttings after the entire soil preparation, afforestation can be done at nearly similar costs, however the regeneration with root ripping means significantly less cost. However, this can't be applied to the extreme, because after a number of root ripping a high degree of degradation can be observed in the stand, as a result of which the assortment composition deteriorates and the tree utilization income decreases.
A well-founded opinion can therefore only be given by summing up the forest tending costs and the income of the extracted wood.

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