

USE OF FAST GROWING TREE SPECIES IN A CROP ROTATION

Case study: Crop rotation of corn and black locust in an arable agroforestry system



THE WHAT AND WHY

Be comfortable with the low productivity from your land?

In a medium or poor-yielding corn-growing area, short rotation tree plantations can be incorporated into a crop rotation in order to improve the soil conditions and to increase the production of the system. One possibility for such agroforestry systems is to plant trees for biomass at high planting density. The establishment of such plantations is justified where the use of other techniques is limited or where higher sales revenues

can be achieved through the delivery of special products. For example, a medium-yield maize growing area can be used to produce poplar or black locust (*Robinia pseudoacacia*) in high yields, the biomass of which is marketable as fuelwood or usable for private purposes. Short rotation coppicing is followed by a transition to arable cropping. In this way, the tree plantation is included in the crop rotation.



Black locust plantation at the age of 3 years planted at 0.5 x 1.5 m spacing
Photo by B. Marosvölgyi

Black locust energy tree bales
Photo by B. Marosvölgyi

HOW IS THE CHALLENGE ADDRESSED

Soil and yield improvement with black locust - crop rotation

Black locust can be renewed by coppicing, so it can be harvested three or five times, totaling a plantation life of up to 10-20 years. (Ref 3) As leguminous plant, it can fix nitrogen from the air into the soil, up to 50 kg ha⁻¹ year⁻¹. Also the foliage falling every year and root die off increases the mineral content (K, Ca, Mg) and thus the microbiological activity of the soil as a result of the input of organic matter. The roots of trees penetrate much deeper (2-5 m) than conventional agricultural plants. The channels made by the roots improve

the soil water infiltration capacity and the conditions to avoid water loss through run-off. Therefore, dense tree plantations can have a positive effect over a long period of time, including the improvement of soil fertility and thus the yield of the subsequent crop. Crop and wood products (timber, woodchip, stumps, roots etc.) of short rotation coppice (SRC) provide regular income for the farmer. The extracted wood can be shredded or baled locally, stored after chopping and used for industrial or private purposes. (Ref 2)



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Keywords: crop rotation, black locust, energy, plantation, fast growing

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HIGHLIGHTS

The main advantage of alternating black locust as SRC crop with annual crops such as maize in a crop rotation is that the former produces renewable energy for local use, whilst significantly increasing soil quality and total biomass yields. The cultivation of black locust for energy purposes gives reasonable yields in poor production areas. Its high energy density and good burning properties make it easy to use.



Strongly spiked stem of a single year black locust in plantation
Photo by B. Marosvölgyi

FURTHER INFORMATION

1. Mantovani D, Veste M, Freese D (2014) Black locust (*Robinia pseudoacacia* L.) adaptability and plasticity to drought. 2nd European Agroforestry Conference: integrating science & policy to promote agroforestry practice. Book of abstracts

https://www.researchgate.net/publication/263062524_Black_locust_Robinia_pseudoacacia_L_adaptability_and_plasticity_to_drought

2. Marosvölgyi, B. (2010): A FAENERGETIKA ÚJ LEHETŐSÉGEI ÉS KORLÁTAI. Kutatói nap : tudományos eredmények a gyakorlatban. Alföldi Erdőkért Egyesület, 2010. http://epa.oszk.hu/03400/03455/00011/pdf/EPA03455_kutato_i_nap_2010_005-010.pdf

3. Rédei K, Csiha I, Keserű Zs, Rásó J, Kamandiné Végh Á (2013) Sarjzatatott akác energetikai faültetvények föld feletti dendromasszája. Erdészeti Lapok CXLVIII. évf. 11. szám (2013. november) http://erdeszetilapok.oszk.hu/01786/pdf/EPA01192_erdeszeti_lapok_2013_11_357_358.pdf

ADVANTAGES AND DISADVANTAGES

Advantages and disadvantages of SRC in rotation with crops

The SRC plantation incorporated as part of a rotation with annual crops is advantageous from various aspects. During the period of SRC production, marketable wood products such as wood chip can be produced either for the producer's own purposes, or the sale of wood chip fulfilling a contract or the sale of them in a free market.

The disadvantage is that methods of evaluating the indirect benefits of the inclusion SRC as part of a crop rotation- such as determining the value of a positive change in the quality of the soil - have not been developed yet. This requires further research. Moreover, as the inclusion of SRC as part of crop rotation applies over a long period of time, both policy and macroeconomic changes as well as economic stability may pose a high risk.

Another risk element is climate change, which can affect biomass yields and the selection of the most suitable tree species.

After the final SRC harvest and before the following maize is sown, the stumps must be removed. Switching from SRC to crop production may also be necessary if the economic conditions become unfavorable for the maintenance of the tree plantation. In this case the area can be returned to agricultural production with suitable technology within 1 year.

The main advantage of the system is that it delivers renewable energy for local use (e.g. heating), at the same time as significantly increasing soil quality and biomass yields whilst reducing the amount of N-fertilisation required for the tree and the subsequent crops due to the presence of leguminous trees. Due to its high energy density and good burning properties, the wood of black locust is easy to use after any mechanical processing (crushing, compacting, baling).

The results of studies from Germany show important benefits concerning drought tolerance, resilience and water use efficiency of black locust. (Ref 1) These qualities of the species are the basic conditions for effective management of an agricultural system under recent climate change extremes.

In areas with low yields, it is justifiable to use black locust to replace agricultural crops where black locust can even achieve higher yields than poplar plantations. Though, due to the specificity of the species (strongly spiked) only fully mechanized technologies can be used.

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