

DESIGNING A PROFITABLE AGROFORESTRY SYSTEM WITH POPLAR

Investigating agroforestry potential with double rows of poplar in arable systems



THE WHAT AND WHY

Agroforestry on cropland as an alternative solution to meet the poplar demand

Today, the decrease in new poplar planting is a very worrying factor for the industry. Over the past twenty years, the rate of poplar replanting in France has decreased from 2.3 million plants per year in the early 1990s to less than 600,000 plants per year in 2013. Today in France, more than one in three parcels is not reforested. This has become very insufficient to ensure the future supply of processing industries.

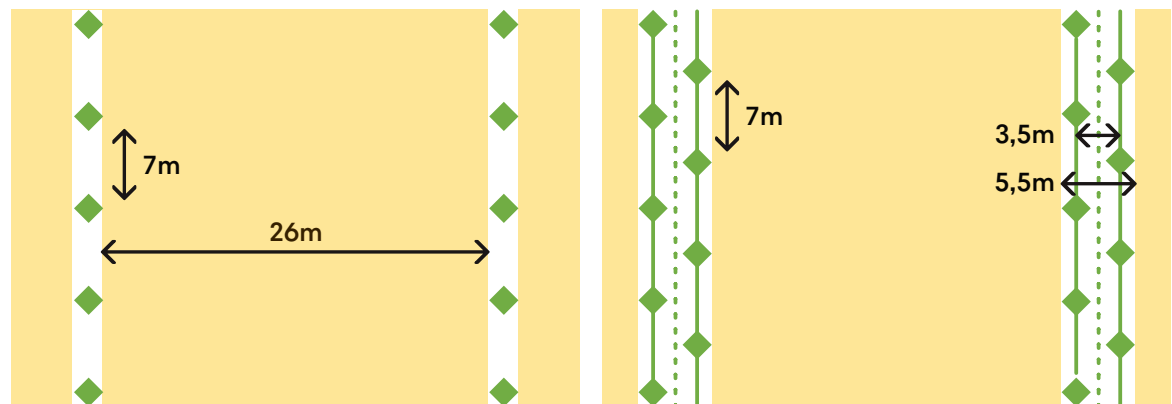
The first signs of supply stress are already being felt such as poorer quality and quantity of log. At the same time, an increasing demand for export in Europe (Italy, Spain), South-East Asia and India adds to this stress. If the rate of replanting

does not increase, and an evolution of the poplar sector is not quickly engaged, the industries are expected to experience a break in their supplies at the beginning of the 2020s.

In this context, agroforestry is seen as an alternative source of raw material for the poplar industry, and a good opportunity of diversification for farmers. However, agroforestry on cropland faces a major issue of competition between trees and crops for light, water and nutrients which can strongly affect the profitability. Proper design has to be implemented to allow effective complementarity between both components of the system.



Agroforestry system of poplars and maize in Haute-Garonne, France.
Credit: Philippe Van Lerberghe © CNPF



From single-rows to double-rows of trees in poplar alley cropping, a way of maximizing the profitability of agroforestry systems.
Credit: Association Française d'Agroforesterie.

HOW IS THE CHALLENGE ADDRESSED

Optimizing line spacing and density with a multiple row design

Arable crops and trees, when present simultaneously on a same field, partly share the same resources: light, water and nutrients. Light has already proved to be one of the main limiting factors to the growth of arable crops in alley cropping agroforestry systems, due to the shading effect of the tree canopies. The wider the crop strips between the tree lines, the lower the impact of shade, hence the expected yield reduction. In general, the minimum distance recommended between tree lines is 20m.

On the other hand, the production of quality timber requires a spacing of 5 to 6m between trees (distances to be adapted to the context and plot characteristics). As a consequence, if poplar lines are more widely spaced, tree density, and thus timber volume production per hectare is reduced. To optimize the tree density, to the level of 100 trees per hectare, it is possible to plant trees in a double-row design. This way both light needs of the crop and a good tree production potential are ensured.



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Keywords: design; profitability; yield; arable crops

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HIGHLIGHTS

- Poplar is a high value, fast growing tree species, and an increasingly scarce resource for the industry. Its integration in agroforestry systems could help increase profitability in the mid-term, if implemented with an appropriate design.
- In agroforestry, wide spacing between trees rows are often advised to mitigate crop yield reduction and allow for the use of large agricultural machinery. Tree lines composed of double-rows appear to be a promising solution to keep a sufficient tree density on the plot, while preserving crop production.
- Based on modelling, double-row designs in poplar agroforestry systems appear to be more profitable than single row layouts.
- Further research is necessary to fine-tune the model developed, especially regarding crop yield reduction, but also to evaluate its applicability to other tree species and crops.



Several rows of poplar are established between agricultural plots sown with maize in Verdun-sur-Garonne, France.

Credit: French Agroforestry Association



watch video

FURTHER INFORMATION

¹Fang et al. 2005. Poplar in wetland agroforestry: a case study of ecological benefits, site productivity, and economics. Wetlands ecology and management.

²Van Lerberghe, P. and Parizel, A. 2019. Le peuplier agroforestier. Cahiers techniques de l'agroforesterie. Ed. CNPF-IDF, 68p. (in press).

ADVANTAGES AND DISADVANTAGES

A lot more to be tested on the field

Double-row design is a common practice in China where poplar agroforestry is well-known. A chinese study published in 2005 compared several layouts of double-rows poplar agroforestry systems to monoculture, and claimed an increase of 46% on the cost/benefit ratio for a 30m-apart double-row layout after 7 years¹. However, this practice is not well-known in Europe, and more references and experiments are needed to fine-tune recommendations and advice for temperate climates.

The **French Agroforestry Association** worked on a technical handbook² to guide practitioners in the implementation of poplar agroforestry systems, both in crop and livestock. In this document, economic modelling shows that a double-row poplar system would outperform a single-row design. With a design of 93 trees/ha (vs 54 trees/ha for the single row), the double-row system would get a EBITDA of 151€/ha and year against 72€/ha and year for the single-row considering a 1.3m³ log of wood per tree after 20 years. This is mainly explained by scale economies and the fact that a quincunx double-row is considered to have no or little impact on wood production (poplar growth).

However, it is currently not possible to estimate the impact of each design on the crop yields, and this needs to be further investigated on the field to understand better the potential of double-row agroforestry systems. A research need is also to validate the different possible configurations, with regard to spacing in the row, between rows and crop types. In a new project, adapted varieties will be selected and tested based on the work of the French poplar experimental network, coordinated by the **National council of forestry owners (CNPF)**.

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