# Agroforestry systems with pollarded walnut trees

## First evaluation by modeling and field monitoring

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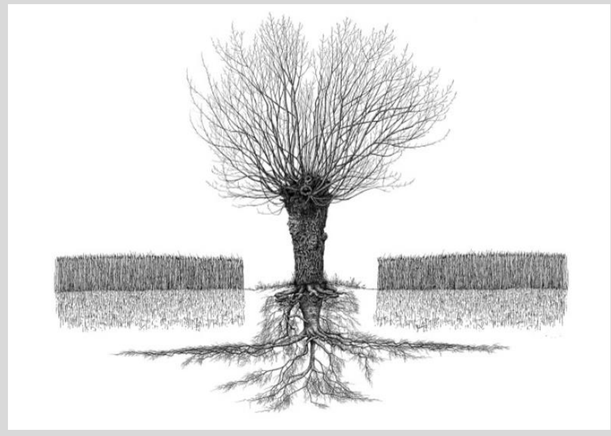



## Background and objectives

In alley cropping systems (AFS), competition for resources determines intercrop yield [1]. Large trees capture resources (light, water, nitrogen), and the intercrop yield decreases as trees grow up. This may drop the intercrop yield to unprofitable levels. We explore if reducing the tree crown size by pollarding could sustain crop production, while allowing to produce both timber (trunk) and biomass (branches)

## Methods

- Field survey :

Hybrid walnut trees aged 18 year were pollarded at 4 m height : 5 trees in winter 2012-13 and 43 trees in winter 2013-14. DBH, branches biomass, leaf traits (SLA, LAI, C/N), phenology and diseases were monitored on pollarded and control stanadrd agroforestry (AF) trees in 2013. Tree spacing is 13 x 8 m.

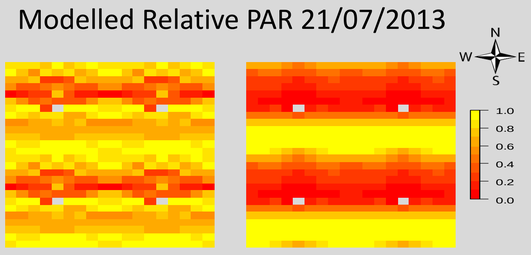
- Modelling :

The Hi-sAFe [2, 3] model was adapted to simulate trees pollarded and compute Land Equivalent Ratios (LER [4]) of the system. The model accounts for competition for light, water and nitrogen between trees and crops.

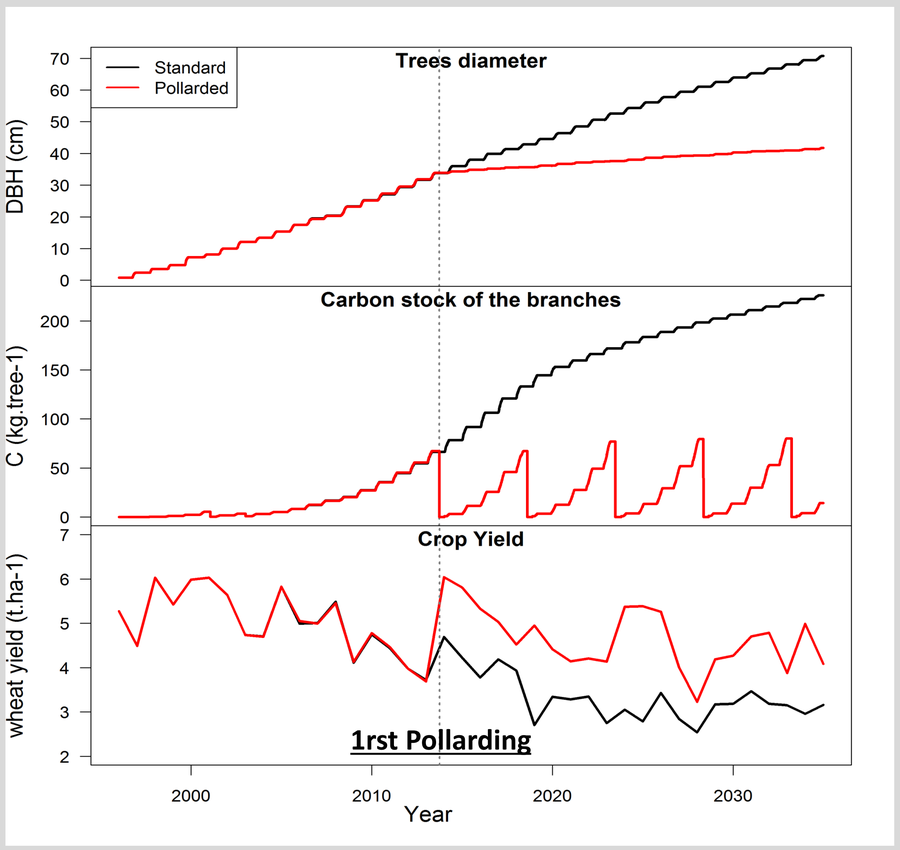

## Results



Modelled Relative PAR 21/07/2013




Pollarded Standard




**Hi-sAFe simulation outputs (1995-2035)**

### LERs with pollarded versus standard trees

| *RYs* | *Trunk* | *Branches* | *Crop* |
|---|---|---|---|
| *Pollarded* | *0.18* | *1.84* | *0.81* |
| *Standard* | *0.62* | *1.1* | *0.68* |

| *LERs* | *Pollarded* | *Standard* |
|---|---|---|
| *Crop & branches* | *2,65* | *1,78* |
| *Crop & timber* | *0,99* | *1,31* |

$$RY = \frac{yield\ in\ association}{yield\ in\ monocrop} \qquad LER = \sum RY$$




*Leaf phenology was highly disturbed by the late pollarding : very delayed leafing until mid-june, and very late leaf fall in automn.*

*Leaf and branches were also strongly modified : continued growth until the winter, very large leaves, dark green leaves indicating N plentiness*

*Surprise : against modelling results, DBH growth was not significantly reduced during the first year after pollarding (p-value : 0,697)*

## Conclusions

**Modelling results indicate that pollarding could be very effective in stimulating the intercrop yield, and that pollarded trees may produce mostly branch biomass, with a strong reduction in the trunk growth. If the farmer is interested in both crop and branch biomass production, AF with pollarded trees is the best option: 1 ha produces as much crop and branches as an astonishing 2.65 ha of the separated systems. If the farmer is interested in crop and timber, AF with standard trees is the best option.**

**However, field evidence during the first year after pollarding did not support such a strong reduction in trunk growth of pollarded trees. Monitoring during the coming years will help sort out this contradiction. The explanation may lay in the dynamics of the carbon reserves of the tree.**

**Pollarded trees were a very traditional agroforestry practice in Europe, and our results indicate that they may prove relevant again in the future.**

References

[1] Dufour et al. 2013. J. of Agronomy and Crop Science. 199 (3):217-227.
[2] Dupraz et al, 2005. SAFE project Report : http://www.montpellier.inra.fr/safe/english/results/final-report/SAFE%20Final%20Synthesis%20Report.pdf
[3] Talbot 2011, Ph. D. thesis : http://tel.archives-ouvertes.fr/tel-00664530
[4] Mead and Willey 1980. Exp. Agric. 16, 217-218.

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