



Hybrid walnut wood quantity and quality: Agroforestry vs. Forestry systems.

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INTRODUCTION

Context

- Agroecological transition of agriculture → emergence of agroforestry in Europe
- Reappearance of trees in the agricultural environment



Growing conditions of agroforestry trees different from those of conventional stands

- Increased exposure to wind
- Access to resources and light
- Human interventions
- Interactions with intercropping/livestock



Parcelle de noyers agroforestiers – mai 2020

➔ Influence of these growth conditions on the process of wood formation and development: changes in the quantity of biomass produced and the quality of the wood

INTRODUCTION

Objectives of the thesis

To study the development of agroforestry trees and the influence of growing conditions in an agroforestry environment on their wood quality:

- Improve our knowledge of xylogenesis and tree physiology,
- Valorize agroforestry wood in the industrial sector.

GROWTH OF AGROFORESTRY TREES



Primary and secondary growth in an agroforestry environment

- Study of thigmomorphogenesis

Juvenile/adult wood transition

→ Two species are mainly studied: hybrid walnut (*Juglans regia x nigra*) and poplar (*Poplar sp*); the agroforestry systems are composed of agroforestry plots and their forest control.

QUALITY OF AGROFORESTRY WOODS



Biochemical composition

- Duraminization
- Wood coloring,
- Valorization of molecules...

Mechanical performance and peeling process

Packaging and building market



Poplar

Agroforestry system
in Lent (Ain)
Independent farmer



Black locust

Dispositif DIAMs
(Mauguio, Hérault),
complementary study
UMR Eco&Sol, INRAE



Walnut

Agrooof

Agroforestry system of
Restinclières (Hérault)
UMR ABSys, INRAE

- Thesis started in January 2020, financed by the Fondation de France, with the involvement of three laboratories





Study of agroforestry walnut

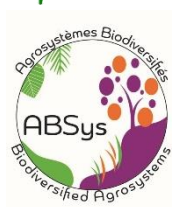
MATERIAL AND METHOD

Agroforestry domain of Restinclières - PIRAT project



INRAE

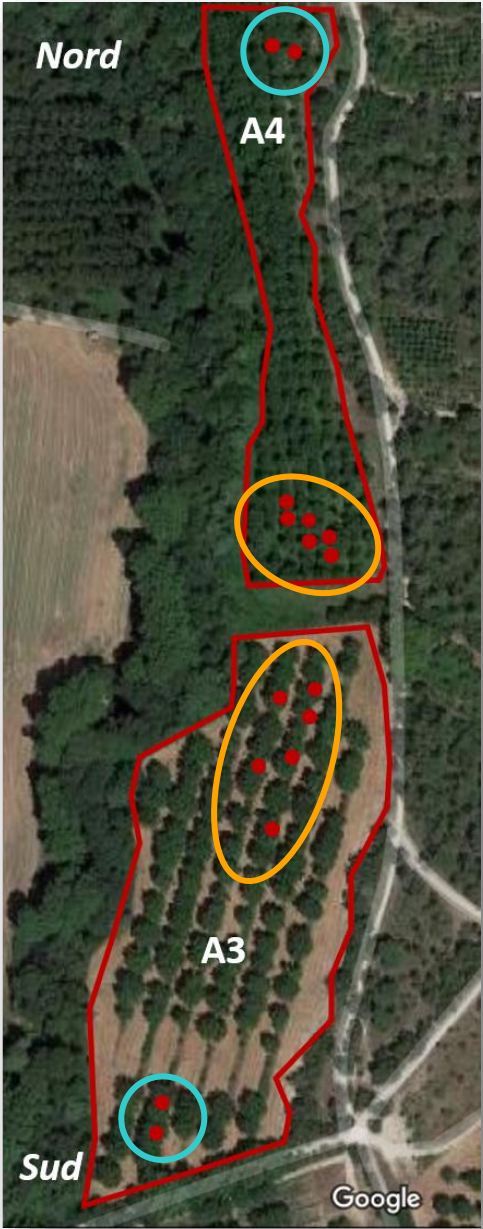
UMR System
Système d'élevage et de culture des systèmes
de culture tropicaux et méditerranéens



- Agroforestry system of Restinclières
Created in 1995 by the UMR System, INRAE
- 45 ha of plantation
- 4 plots growing hybrid walnut trees
(Juglans x regia x nigra NG 23xRA) :
 - A1 : Walnut trees + short rotation
coppice species
 - A2AF : walnut trees + crops
 - A2F : walnut trees, forest control
 - A3 : walnut trees + crops
 - A4 : walnut trees, forest conditions

MATERIAL AND METHOD

Description of the plots



FOREST CONTROL
PLOT



Densité de plantation : ~ 200 arbres/ha

AGROFORESTRY
PLOT



Densité de plantation : ~ 100 arbres/ha

MATERIAL AND METHOD

Studies conducted on walnut trees

- **Study of the primary and secondary growth of walnut trees**
 - Annual monitoring of height and girth
- **Study of the quality of agroforestry walnut trees**
 - Felling of 16 walnut trees in March 2020
 - 8 AF and 8 F
 - Comparative study of the aptitude for peeling of agroforestry walnut trees and the quality of the wood through the phenomenon of duraminization



FOREST CONTROL
PLOT



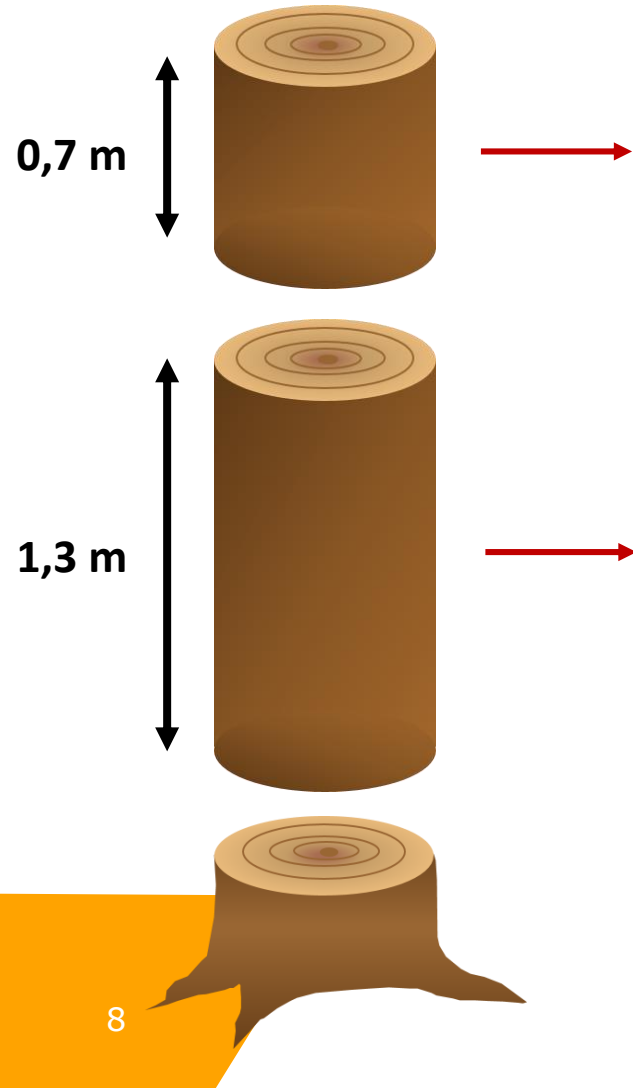
Planting density: ~ 200 trees/ha

AGROFORESTRY
PLOT



Planting density: ~ 100 trees/ha

MATERIAL AND METHOD



- Sapwood/heartwood ratio
- Detection of reaction wood areas
- Colorimetry
- Anatomy
- Infradensity
- Extractible rate

- Peeling & micro-peeling
- Colorimetry on veneer

Extractions au Soxhlet



Peeling line - LaBoMaP



Walnut veneer



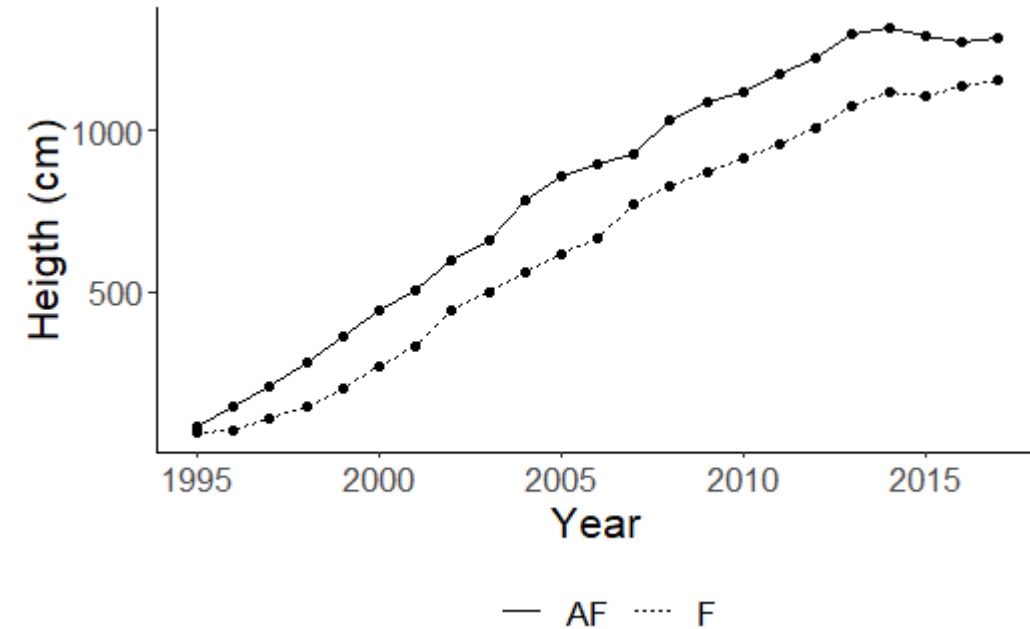
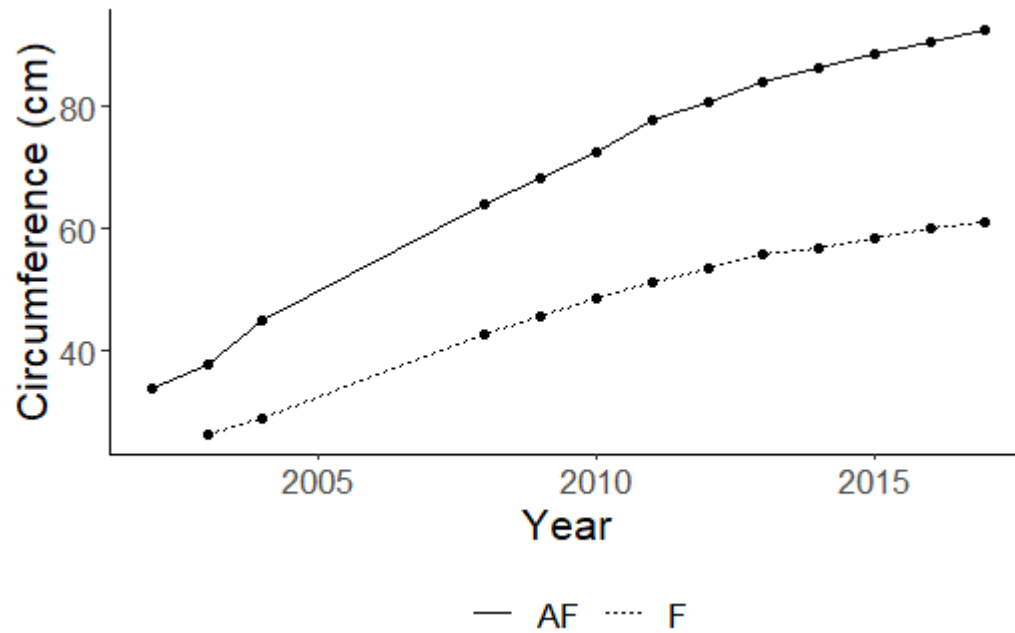
Some results

Growth of walnut trees



RESULTS & DISCUSSION

Comparison of height and diameter growth of agroforestry and forestry walnut trees

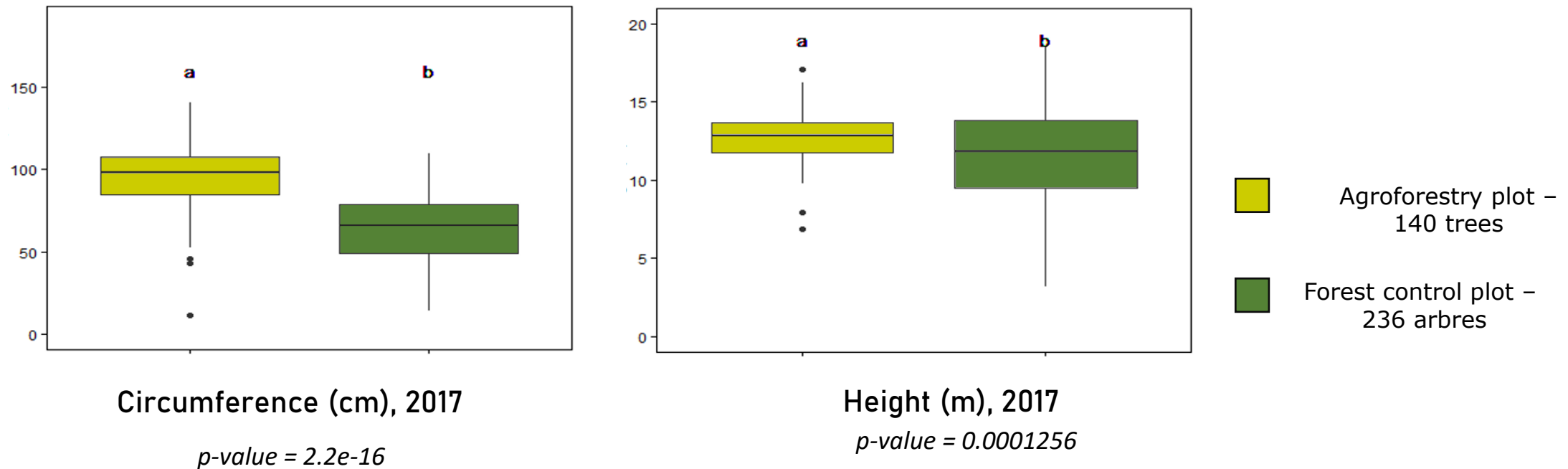


- **Radial growth of walnut trees in AF plot (92 cm) is greater than those in FC plot (67 cm) – 2017**
 - Consistent with other studies conducted on agroforestry trees
- **The height of walnut trees in AF plot (12,8 m) is also more important than those of trees from FC plot (11,5 m) - 2017**

(Coutand et al., 2008 ; Cabanettes et al., 2004 ; Niez et al., 2019)

RESULTS & DISCUSSION

Comparison of height and diameter growth of agroforestry and forestry walnut trees



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CONCLUSION



Agroforestry walnut plot



Agroforestry poplars

Study of the growth and development of agroforestry poplars and their suitability for peeling

- **Agroforestry walnut wood quality analyses in progress**
- **Growth of agroforestry walnut trees: AF walnut trees produce more biomass than F walnut trees;**
- **AF walnut trees taller and wider than F walnut trees**



Trained Robinia vs. free winding Robinia

Study of the effect of wind on the growth of agroforestry trees (thigmomorphogenesis) in comparison with their forest controls

Thank you



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