Alley coppice: an innovative land use system - options of system design with experimental evidence

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Project
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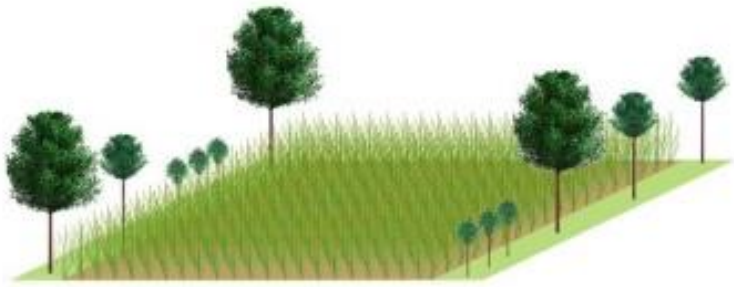
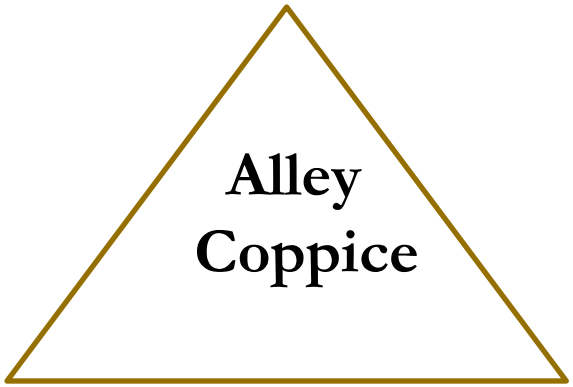
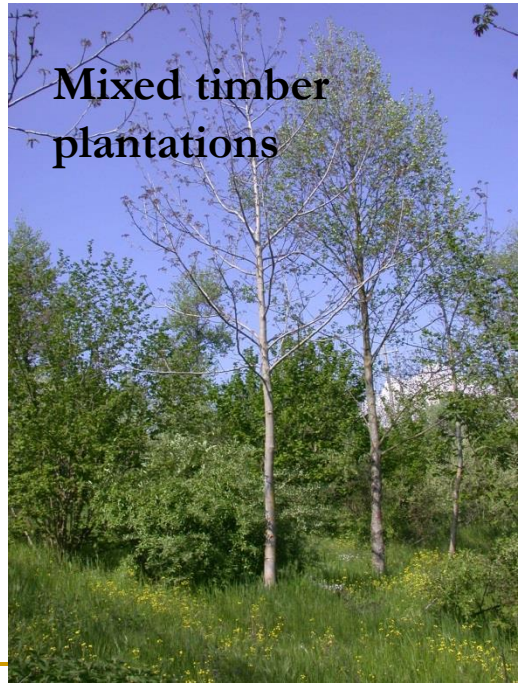
What is alley Coppice?



Cultivation of multipurpose plantation producing biomass and logs for industry combining SRC (e.g. poplars, willows) and valubale timber trees (e.g. walnut, w. cherry, *Sorbus*) on agricultural land





Morhar et al., 2014. Alley coppice – A new system with ancient roots. Annals of Forest Science

Why Alley Coppice?

i) the farmers can receive payments for biomass every 2-5 years during juvenile phase of the high value timber trees;
ii) the timber trees can be planted at final spacing, avoiding plantation thinning;
iii) the SRC, with a rapid canopy closure, has a positive environmental impact, reducing soil erosion and increasing biodiversity;
iv) the SRC can protect the timber trees from wind and storm;
v) a modulated light competition of SRC towards the timber trees causes the correct growth of their stem, reducing pruning intensity.

Biomass harvesting cost in mixed plantations vs SRC

Thinning in mixed plantations: 25-50 €/fresh t (chips/fuelwood)(1)

Harvesting in SRC: Circa 5 € fresh t (2)

Poster. Social and economic evaluation of innovative alley coppice systems mixing timber trees with bioenergy wood crops in agroforestry systems

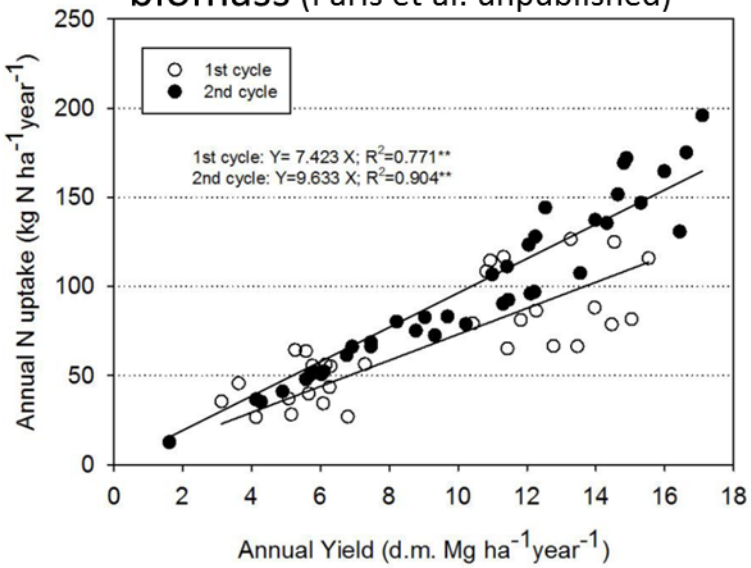
[1]Magagnotti et al., 2012 Biomass & Bioenergy; [2]El Kasmioui, R. Ceulemans, 2012. Biomas and Bioenerg; Manzone et al, 2009. Biomas & Bioenrg

Problems!!!!!!!

SRC trees (poplars/willows/eucalypts) are fast growing and demanding crops, potentially very competitive towards timber trees

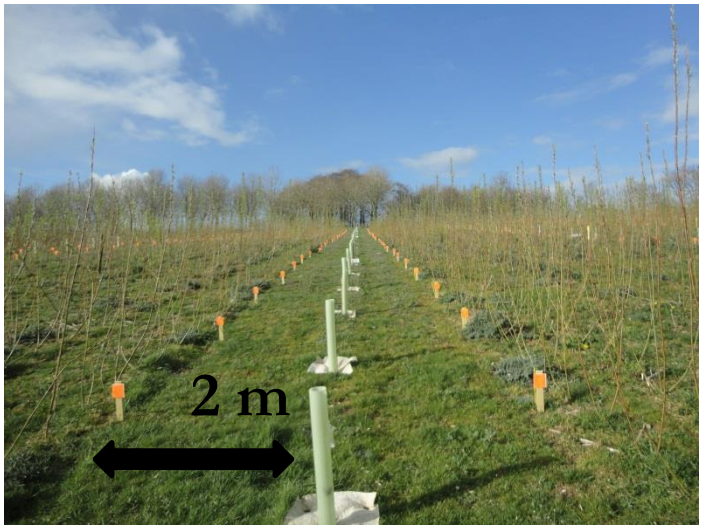
Crop (from literature)	'Irrigation' Crop coeff . (Kc) max
Poplar SRC	3,4
Sorghum	1,5
Sunflower	1,12
Corn	1,2
Olive tree	0,7

Poplar SRC
Nitrogen Uptake in the harvested biomass (Paris et al. unpublished)



Three alley coppice designs

- Simultaneous planting
- Lagged planting
- Border planting

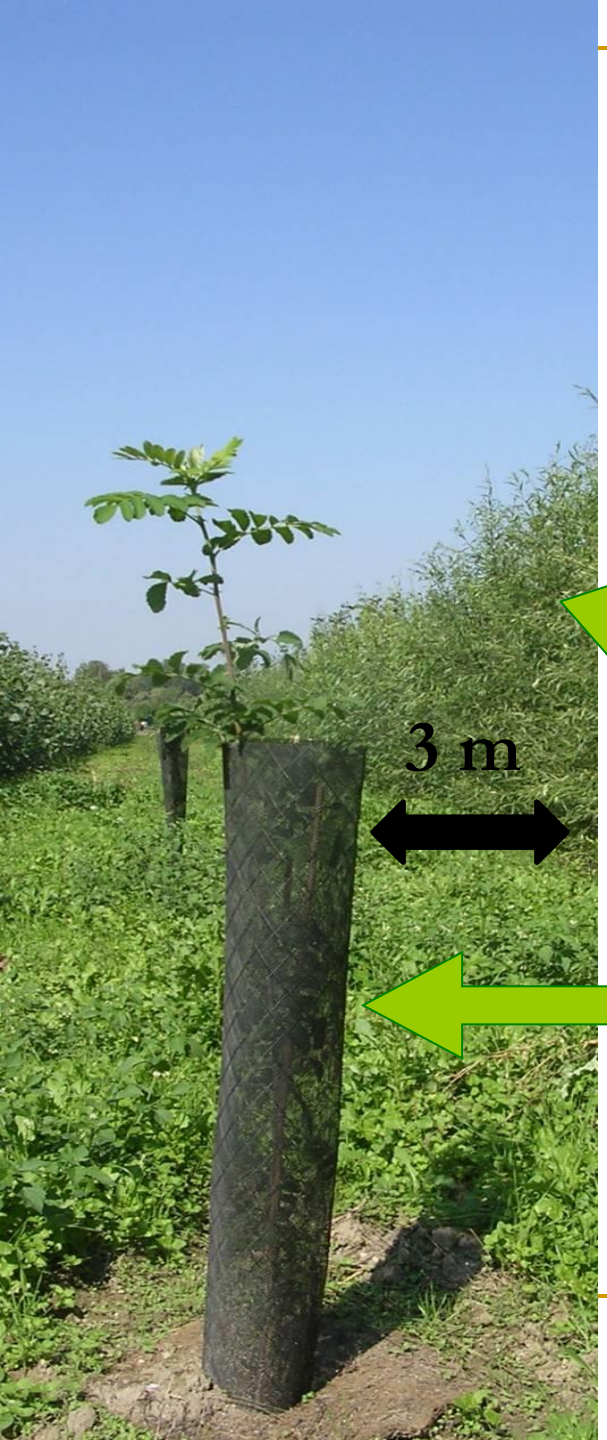


Photos from Ireand, March 2014

First Results from 2 exp. plantations

Site of Domaine de Restinclières, INRA (Lagged planting) Hybrid walnut (18 years) and poplar SRC (2 years)

Site of Casale M.(simultaneous planting in 2007) *Pyrus/Sorbus* and poplar SRC (biennial cycle)



The experimental plantation in Casale M., Italy

TIMBER AND BIOENERGY TREES

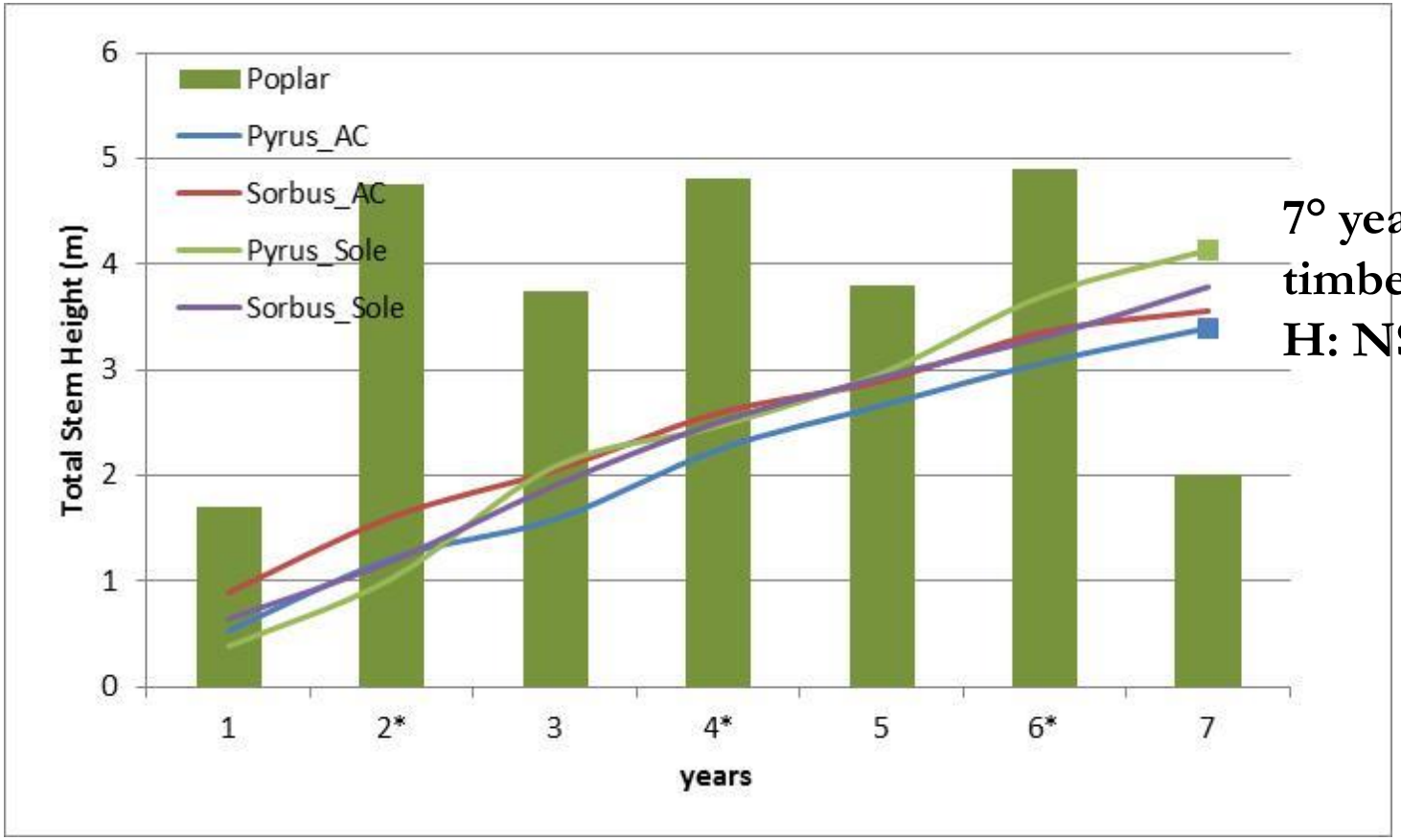
Poplar , 3 hybrid cultivars,
to produce biomass for energy

+

Hardwood species *Pyrus, Sorbus,* to produce wood for industry

CRA

Results Timber and poplar tree growth stem height (H)



7° years timber H: NS

Years with *: harvesting of poplar SRC

Light Competition - Hemispherical photos

Timber trees

Timber trees + SRC

Treatments	Camera Position (and date)	Along timber tree row (29 Apr. 2013)	Poplar top canopy (7 Aug. 2013)
		Total light transmittance (%)	
Alley Coppice		66.05 (2.35)	98.52 (0.15)
Sole timber		99.45 (1.3)	-

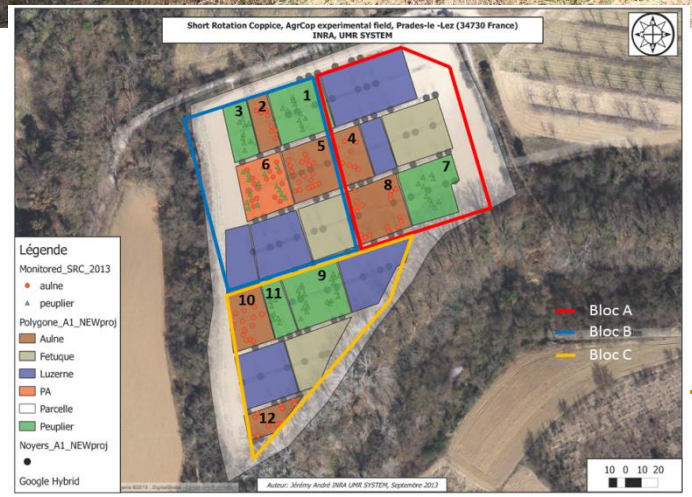
Wood quality of timber trees (Q)

Q = 3L– (+ F +DI + DF + DM + CF + Kn + EB)

L= log morphology coef. (log length and stem straightness);
E = stem eccentricity;
F= fiber orientation;
ID = insects damages;
FD = bacteria/fungi damages;
MD = mechanical damages;
CF = presence/absence of critical fork;
Kn = knots;
EB= epicormic branches

Treatments	Q_{ave}
Alley Coppice	3.7* (0.815)
Sole timber	2 (0.72)

* $p \leq 0.05$ according to Friedman's Test



The experimental plantation In Montpellier Restinclières (France)

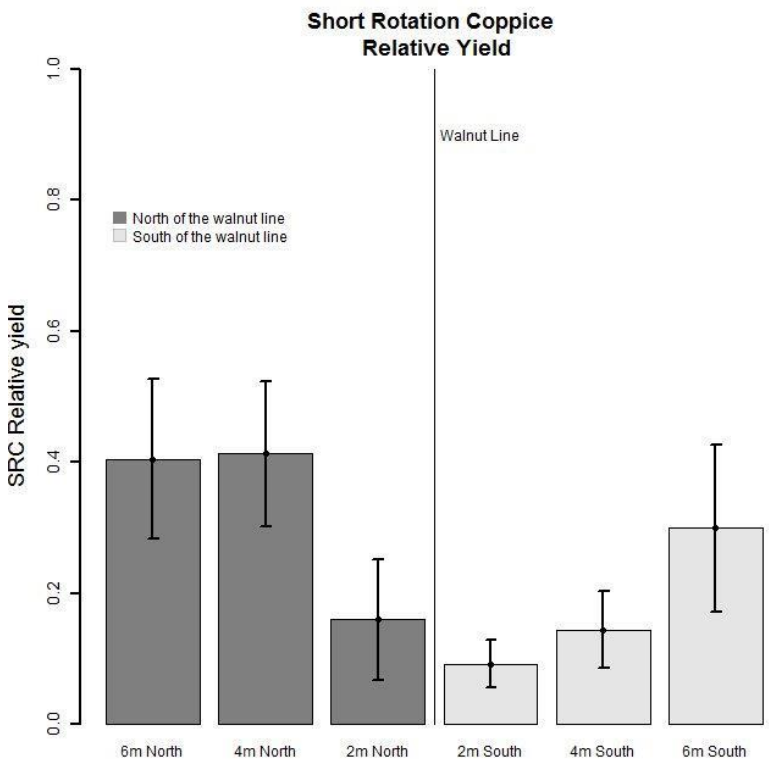
TIMBER AND BIOENERGY TREES on 1,5ha

Poplar cultivar Monviso,
to produce biomass for energy

+

18 year old hardwood species *Juglans regia x nigra L.*,
to produce wood for industry

Results at 1st coppicing (Poplar SRC: 2 year old)

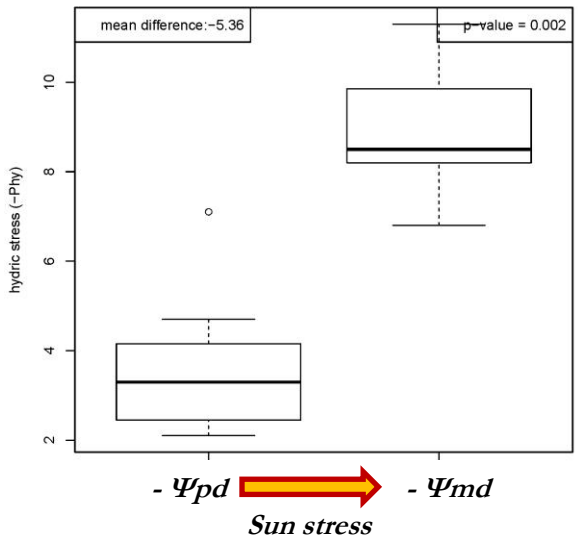


- **Low SRC yield average**
  - *Pure SRC: 1 Mg (DM)/ha/year*
  - *AC SRC: 0,3 Mg (DM)/ha/year*

Severe drougth during the first year of establishment (2012)

Leaf Water Potentials of Poplar SRC

Water stress for pure SRC (| *Ψpd*/ - /*Ψmd*/)



In Alley coppice system)

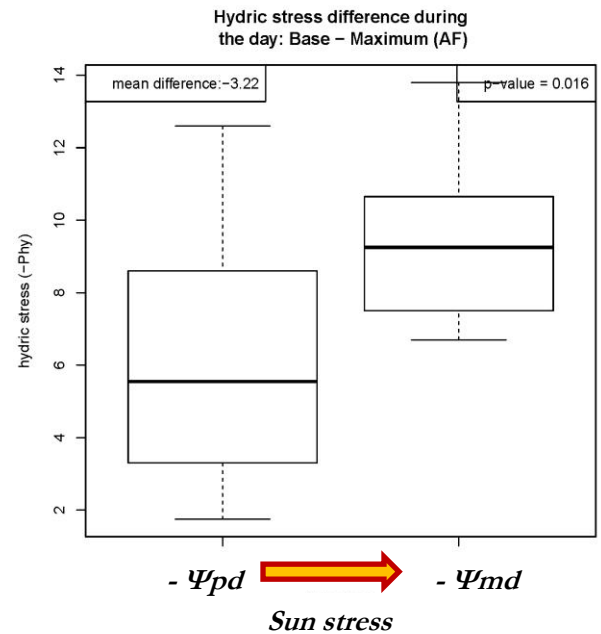
(| *Ψpd*/ - /*Ψmd*/)

<

Than in pure SRC

(p-value = 0,03)

Water stress for AC-SRC (| *Ψpd*/ - /*Ψmd*/)



- **Strong competition for ressources aquisition and use :**
  - *SRC water stress (- Ψpd) in AC SRC > pure SRC (p-value=0,002)*

- **SRC water stress mitigated by agroforestry microclimate conditions**:
  - *(Ψpd – Ψmd) in AC SRC < pure SRC*

Concluding remarks

- LP site (France): the first coppicing cycle resulted in very low yields.
- LP site: the competition for light and water from the 18 year old walnut trees had strong negative effects on the SRC.
- It is not yet possible to conclude if LP can be used for the establishment of Agrocop systems.
- SP site (Italy). Co-planting seems to enhance complementarity for resources acquisition and use. It may be due partly to below-ground optimized co-development.

- **In Alley Coppice, preliminary benefits on timber wood quality and from SRC micro-climate have been observed. These benefits have to be further explored for system optimization**.

Acknowledgement for supporting the AgroCop Project to

WoodWisdom-Net