



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

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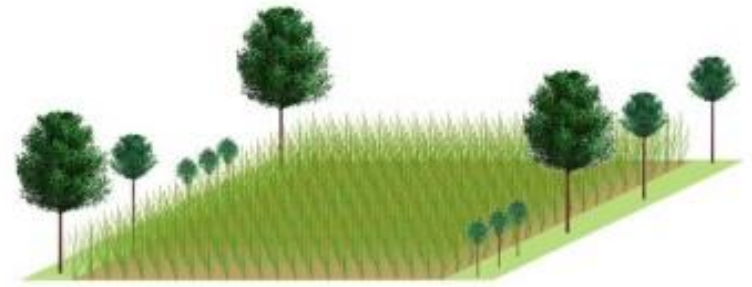
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What is alley Coppice?

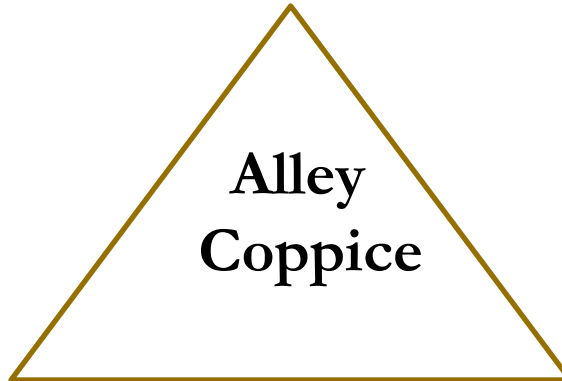
Cultivation of multipurpose plantation producing biomass and logs for industry combining SRC (e.g. poplars, willows) and valuable timber trees (e.g. walnut, w. cherry, *Sorbus*) on agricultural land



Coppice with standards



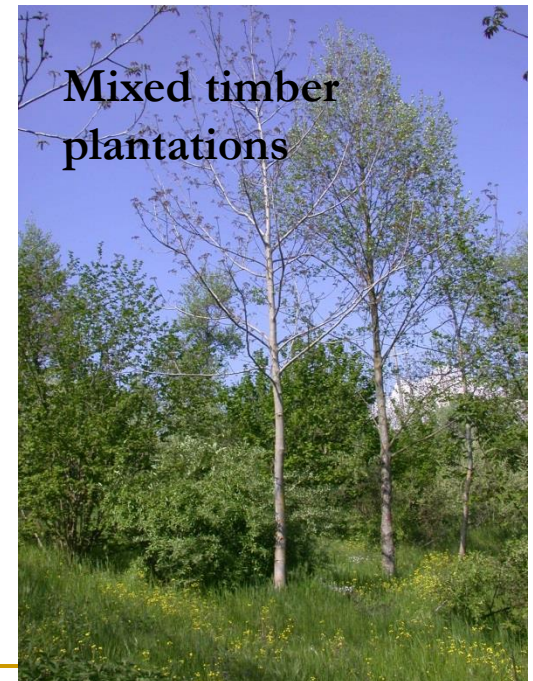
**Alley
Coppice**



Alley cropping



**Mixed timber
plantations**



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

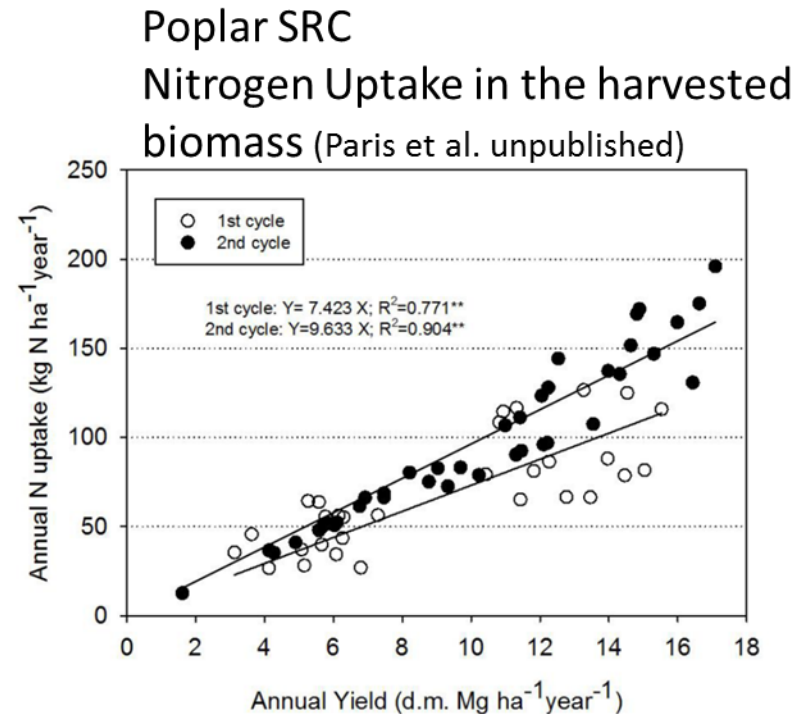


¹Magagnotti et al., 2012 Biomass & Bioenergy; ²El Kasmioui, R. Ceulemans, 2012. Biomass and Bioenergy; Manzone et al, 2009. Biomass & Bioenergy

Problems!!!!!!!

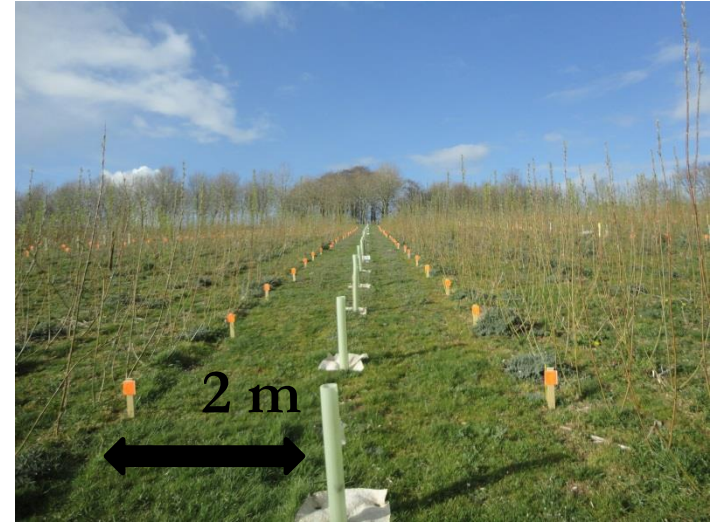
SRC trees (poplars/willows/eucalypts) are fast growing and demanding crops, potentially very competitive towards timber trees

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



Three alley coppice designs

- Simultaneous planting
- Lagged planting
- Border planting



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)**

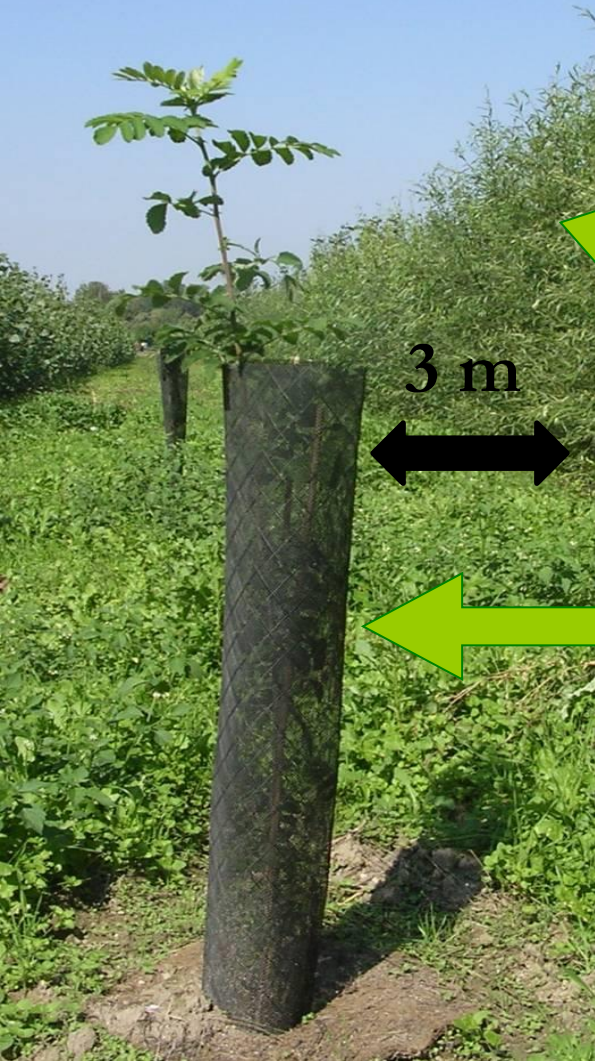
The experimental plantation in Casale M., Italy

TIMBER AND BIOENERGY TREES

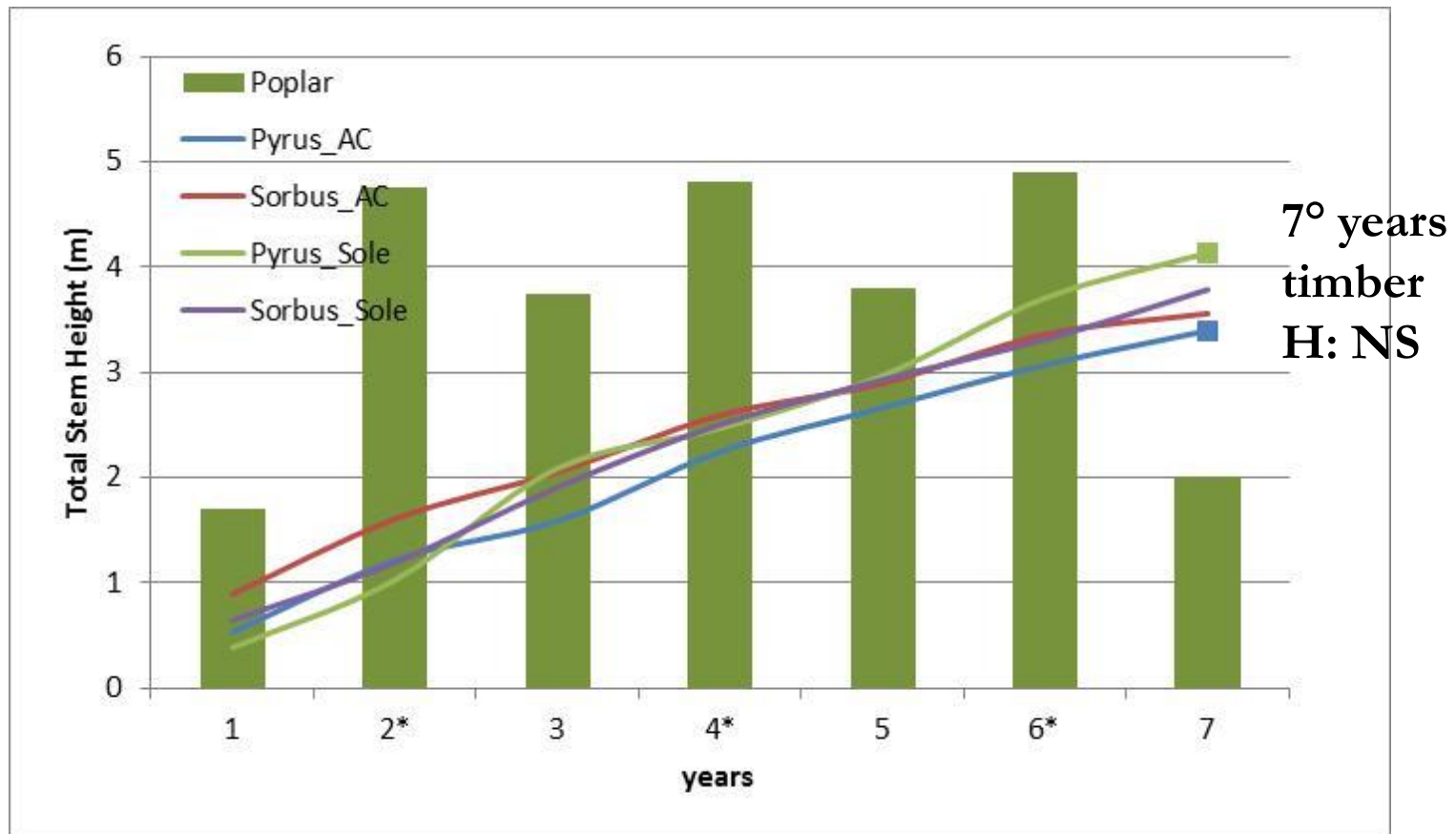
Poplar , 3 hybrid cultivars,
to produce biomass for energy

+

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



Results Timber and poplar tree growth stem height (H)



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

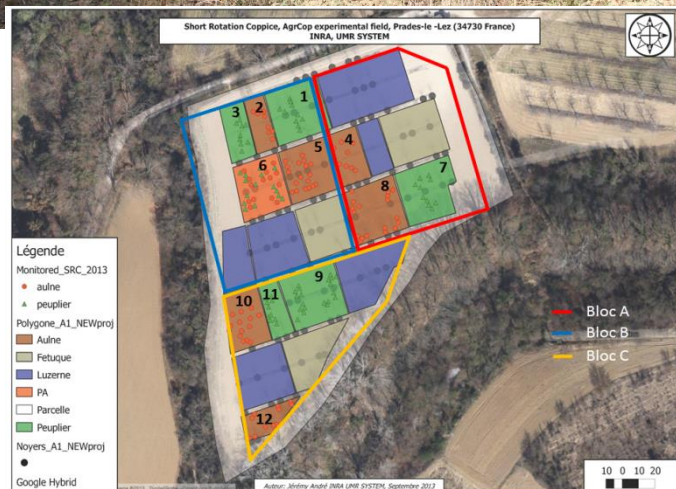
The experimental plantation In Montpellier Restinclières (France)

TIMBER AND BIOENERGY TREES on 1,5ha

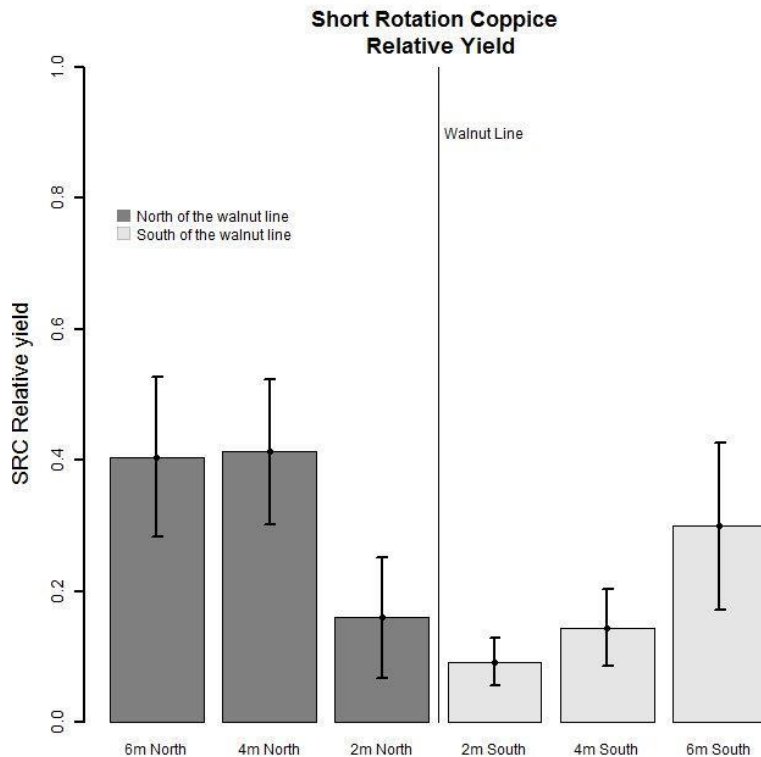
Poplar cultivar Monviso,
to produce biomass for energy

+

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



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



- **Low SRC yield average**

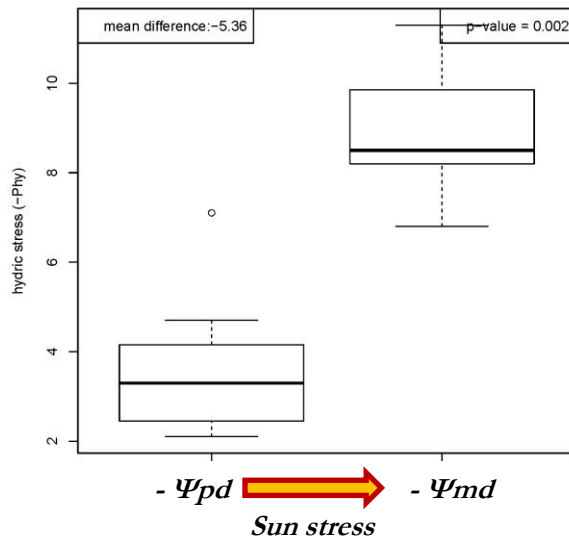
- *Pure SRC: 1 Mg (DM)/ha/year*

- *AC SRC: 0,3 Mg (DM)/ha/year*

Severe drought during the first year of establishment (2012)

Leaf Water Potentials of Poplar SRC

Water stress for **pure SRC** ($|\Psi_{pd}| - |\Psi_{md}|$)

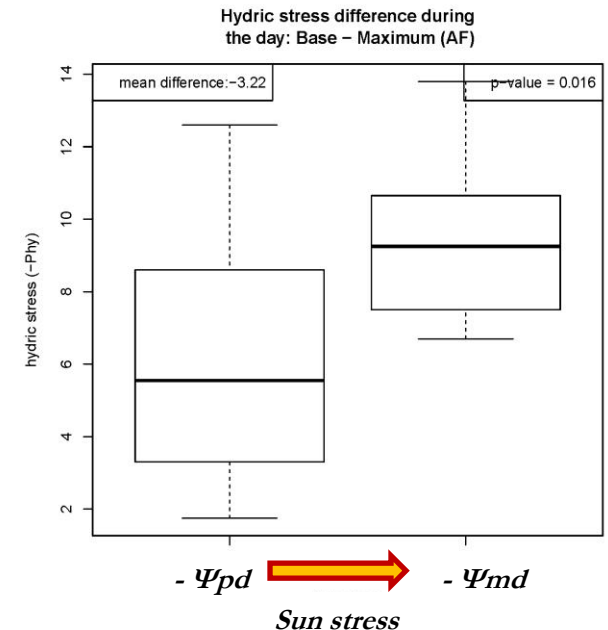


In Alley coppice system)
($|\Psi_{pd}| - |\Psi_{md}|$)

<

Than in **pure SRC**
($p\text{-value} = 0,03$)

Water stress for **AC-SRC** ($|\Psi_{pd}| - |\Psi_{md}|$)



- **Strong competition for resources acquisition and use :**
 - *SRC water stress ($-\Psi_{pd}$) in AC SRC > pure SRC ($p\text{-value}=0,002$)*

- **SRC water stress mitigated by agroforestry microclimate conditions:**
 - *($\Psi_{pd} - \Psi_{md}$) 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.**

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WoodWisdom-Net