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


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

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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 cropping

Mixed timber plantations

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)

Problems!!!!!!!

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

<table>
<thead>
<tr>
<th>Crop (from literature)</th>
<th>‘Irrigation’ Crop coeff. (Kc) max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poplar SRC</td>
<td>3,4</td>
</tr>
<tr>
<td>Sorghum</td>
<td>1,5</td>
</tr>
<tr>
<td>Sunflower</td>
<td>1,12</td>
</tr>
<tr>
<td>Corn</td>
<td>1,2</td>
</tr>
<tr>
<td>Olive tree</td>
<td>0,7</td>
</tr>
</tbody>
</table>

Poplar SRC Nitrogen Uptake in the harvested biomass (Paris et al. unpublished)
Three alley coppice designs

• Simultaneous planting

• Lagged planting

• Border planting

Photos from Ireland, 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
Results

Timber and poplar tree growth stem height (H)

Years with *: harvesting of poplar SRC

7° years timber H: NS
## Light Competition - Hemispherical photos

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Alley Coppice</td>
<td></td>
<td>66.05 (2.35)</td>
<td>98.52 (0.15)</td>
</tr>
<tr>
<td>Sole timber</td>
<td></td>
<td>99.45 (1.3)</td>
<td>-</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Treatments</th>
<th>( Q_{ave} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alley Coppice</td>
<td>3.7* (0.815)</td>
</tr>
<tr>
<td>Sole timber</td>
<td>2 (0.72)</td>
</tr>
</tbody>
</table>

* \( p \leq 0.05 \) 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 1\textsuperscript{st} 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

- Strong competition for resources acquisition and use:
  - SRC water stress ($\Psi_{pd}$) in AC SRC > pure SRC ($p$-value=0.002)

- SRC water stress mitigated by agroforestry microclimate conditions:
  - ($\Psi_{pd} - \Psi_{md}$) in AC SRC < pure SRC ($p$-value = 0.03)
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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