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.
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 unpublished)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 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
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>
<th></th>
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</tr>
</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≤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 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:**
  - \( \text{SRC water stress (-Ψpd) in AC SRC} > \text{pure SRC (p-value=0.002)} \)

- **SRC water stress mitigated by agroforestry microclimate conditions:**
  - \( (Ψpd - Ψmd) \text{ in AC SRC < pure SRC} \)

In Alley coppice system: \( (|Ψpd| - |Ψmd|) \text{ < Than in pure SRC (p-value = 0.03)} \)
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.

Acknowledgement for supporting the AgroCop Project to...