RESULTS OF INNOVATIVE CROPPING SCHEMES FOR INTEGRATED FOOD-AND-BIOMASS CROPS

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➢ **Project title**: Brazil-EU Cooperation for Development of Advanced Lignocellulosic Biofuels

➢ **Coordinator**: University of Bologna (Prof. Andrea Monti)

➢ **12 Partners**

➢ **General objective**: Strengthen the EU-Brazil cooperation on advanced lignocellulosic biofuels

➢ **Twin Brazilian Project**: BioValue (20 Partners)

➢ **Project duration**: 2017-2022
BECOOL kick off meeting in Bologna

Kick off: Brazilian coordinators and governatives joined the meeting

December 2019 Technical meeting in Recife (Br)
Synergistic/complementary activities between BioVAULE and BECOOL
General objective of WP1: to increase lignocellulosic biomass production and feedstock diversification without reducing food crop land.

How to reach this target???

=> Identifying integrated cropping systems including lignocellulosic and food crops
State of the art:

2/3 of arable land in EU-28 is dominated by conventional crop rotations based on only two main food species (e.g. wheat-maize rotation)
The today cropping systems could be intensified and diversified including lignocellulosic crops.
Potential advantages of innovative cropping systems

1. Enhanced **soil fertility** due to positive rotational effects

2. Reduced **soil erosion** due to a longer land cover

3. Sustainable cropping systems due to **low inputs** requirements (agrochemicals, fertilizers etc.)

4. **Market opportunities** and reduced economic **risks** for farmers

5. Production of feedstock **without competing** with food land
Challenges of the innovative cropping systems

1. Identify the crops

2. New farming systems and machineries

3. Innovative logistic concepts

4. Sometime unfamiliar crops for farmers
Challenges of the innovative cropping systems

- The performance of new crops is quantitatively and qualitatively evaluated (e.g. sunn hemp, fibre sorghum, kenaf and industrial hemp)

- Field studies are replicated in Italy, Greece and Spain

New cropping systems at the experimental farm of the University of Bologna
The integrated cropping systems including food and lignocellulosic crops are:

- **C**: maize – wheat – fallow – maize (control rotation)
- **R1**: maize – sunn hemp+ wheat – sunn hemp – maize
- **R2**: maize – biomass sorghum+ wheat – sunn hemp – maize
- **R3**: maize – kenaf+ wheat – sunn hemp – maize
- **R4**: maize – hemp+ wheat – sunn hemp – maize
- **R5**: sunn hemp + wheat – sunn hemp+ wheat

### Challenges of the innovative cropping systems

<table>
<thead>
<tr>
<th>Code</th>
<th>Crop 1</th>
<th>Crop 2</th>
<th>Crop 3</th>
<th>Crop 4</th>
<th>Crop 5</th>
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</thead>
<tbody>
<tr>
<td>C</td>
<td>Maize</td>
<td>Wheat</td>
<td>Maize</td>
<td>Wheat</td>
<td>Maize</td>
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<tr>
<td>R1</td>
<td>Maize</td>
<td>Sunn Hemp</td>
<td>Wheat</td>
<td>Sunn Hemp</td>
<td>Maize</td>
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<tr>
<td>R2</td>
<td>Maize</td>
<td>Fiber sorghum</td>
<td>Wheat</td>
<td>Sunn Hemp</td>
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<td>R3</td>
<td>Maize</td>
<td>Kenaf</td>
<td>Wheat</td>
<td>Sunn Hemp</td>
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<td>R4</td>
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<td>Hemp</td>
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<td>R5</td>
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</tbody>
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**Note:**
- **Green**: food crop
- **Orange**: legume
- **Blue**: energy crop

RCBD with 4 reps
Example of new crop: sunn hemp (*Crotalaria juncea* L.)

- A tropical Asian legume crop (Fabaceae).
- Widely grown throughout the tropics and subtropics as a source of **green manure**, **fodder** and **lignified fiber**
- Possible source of protein (37% content in seeds)

**Sunn hemp in rotation system:**

**Advantages:**
- Resistance to root-knot nematodes
- Through biological N\(_2\) fixation, it can improve soil fertility and the yields of succeeding food crops
- Low input requirements

**Disadvantages:**
- New to EU environments
- Limited information available on the rotational effect of sunn hemp
Energy crops harvest in Italy (August – September 2018)

- Hemp harvesting with mowers
- Kenaf harvesting with shredder
- Sorghum harvesting with shredder
- Field drying
- Baling
- Weighing
Wheat succeeding energy crops

Quick seedbed preparation
November 2018

Sowing
November 2018

Wheat emergence
December 2018

Wheat elongation
April 2019

Wheat fully ripe
June 2019

Harvesting
July 2019

Weighing
July 2019

Sowing
November 2018
Sunn hemp succeeding wheat

- Quick seedbed preparation
  - July 2019
- Sowing
  - July 2019
- Sunn hemp emergence
  - July 2019
- Sunn hemp harvesting
  - October 2019
- Windrowing
  - October 2019
- Baling
  - October 2019
- Subsoiling
  - October 2019
Wheat grain production following the energy crops was not affected.

The preliminary results indicate that the tested systems are promising and that dedicated energy crop can coexist with food crops.

Biomass sorghum seems to be the highest yielding crop but it was affected by lodging that hampered the mechanical harvest.

Industrial hemp and sunn hemp mechanical harvesting should be improved even though the yields were satisfactory.

High kenaf humidity at harvest and low yield.

Further evaluation are ongoing (soil and biomass qualitative analysis).
Thanks for your attention

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