BECOOL

Brazil-EU Cooperation for Development of Advanced Lignocellulosic Biofuels

LIGNOCELLULOSIC CROPS IN ROTATION WITH FOOD CROPS

A. Parenti,
W. Zegada-Lizarazu,
A. Borghesi,
A. Monti

Department of Agricultural and Food Sciences, University of Bologna
Email: a.monti@unibo.it

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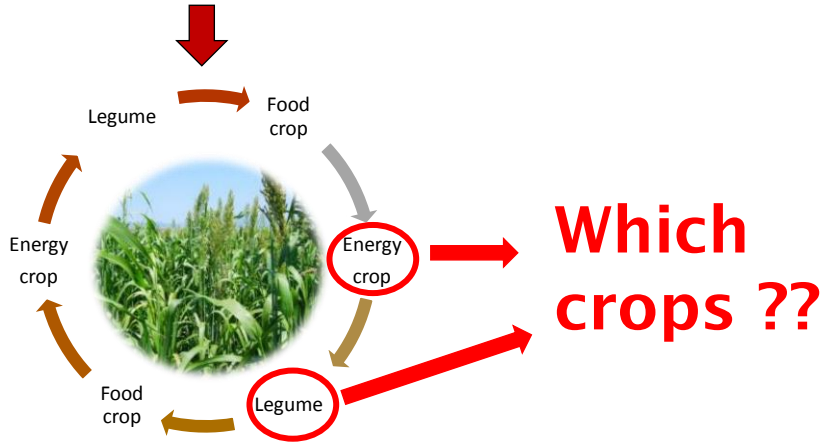
BACKGROUND

- **2030**: **14%** renewable energy in the transport sector, **3.5%** of **advanced biofuels**
- Net **zero carbon emissions** by **2050**
- A **20 times** increase of agricultural and forestry by-products for **advanced biofuels** is expected in **ten years** time.

- **Suitable characteristics of lignocellulosic biomass for advanced biofuel**:
  - high biomass yielding
  - low input
  - sustainable
  - qualitatively acceptable in terms of ash, fibre and minerals

New cropping schemes: the concept

The today cropping systems could be intensified and diversified including lignocellulosic crops



Sunn hemp

Latin name	*Crotalaria juncea* L.
Origin	India
Main characteristics	C3, legume, quick growing, N-fixing ability, suppress weed and some soil-borne disease
Reference yields	**10-15 Mg ha^{-1} dw**

Biomass sorghum

Latin name	*S. bicolor x S. sudangrass*
Origin	Africa
Main characteristics	C4, cereal, saline and drought resistant, deep rooting system
Reference yields	**20-30 Mg ha^{-1} dw**

Hemp

Latin name	*Cannabis sativa* L.
Origin	Central Asia
Main characteristics	Good forecrop for cereal, suppress weed and some soil-borne disease, early harvest
Reference yields	**10-20 Mg ha^{-1} dw**

Kenaf

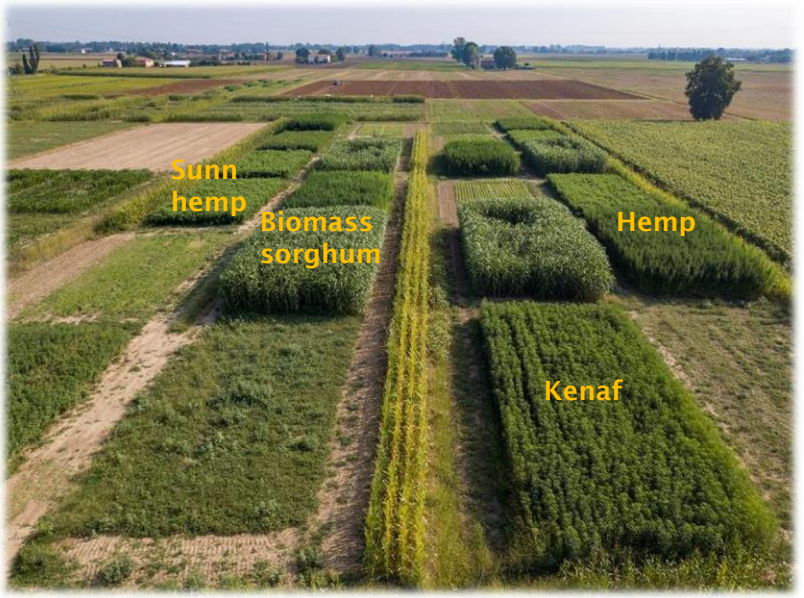
Latin name	*Hibiscus cannabinus* L.
Origin	South Asia
Main characteristics	Weed reduction, control of soybean stunt nematode, drought resistant
Reference yields	**15-20 Mg ha^{-1} dw**

OBJECTIVES

- **To evaluate the biomass yields and quality of four dedicated lignocellulosic crops to advanced biofuels**
- **To assess the effect of such crops on the yields of a subsequent winter cereal production**

THE FIELD EXPERIMENT

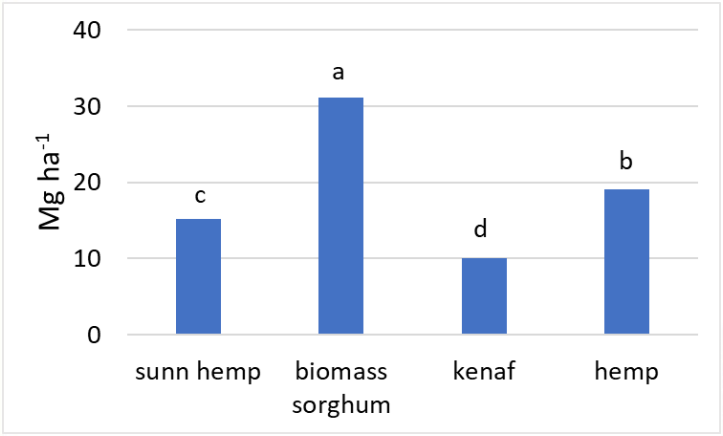
RCBD with 4 reps



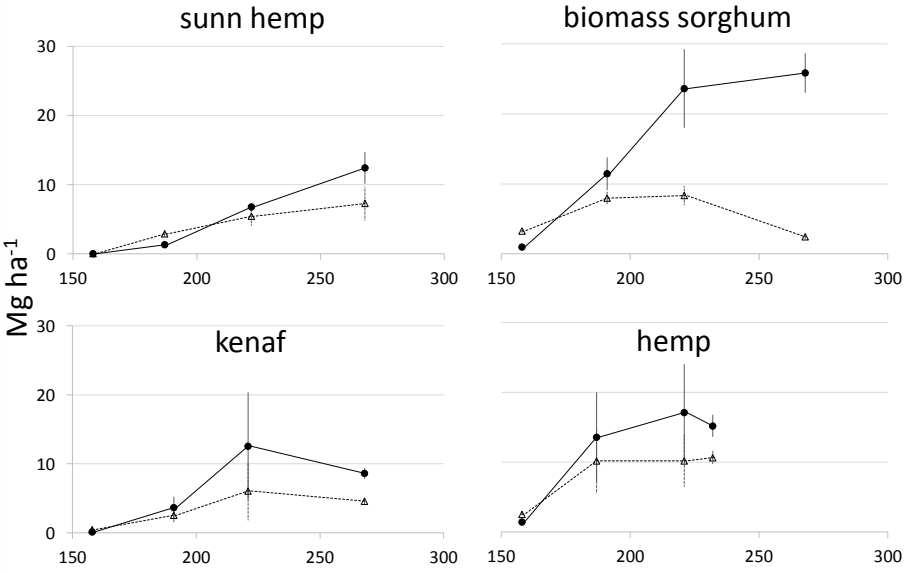
CROP SEQUENCE

	PLANTING	HARVESTING	PLANTING	HARVESTING	
R1	27 Apr 2018	25 Sep	19 Nov	2 Jul 2019	
	Sunn hemp		wheat		
R2	27 Apr 2018	25 Sep	19 Nov	2 Jul 2019	
	Biomass sorghum		wheat		
R3	8 May 2018	25 Sep	19 Nov	2 Jul 2019	
	Kenaf		wheat		
R4	24 Apr 2018	20 Aug	19 Nov	2 Jul 2019	
	Hemp		wheat		

ABOVEGROUND BIOMASS



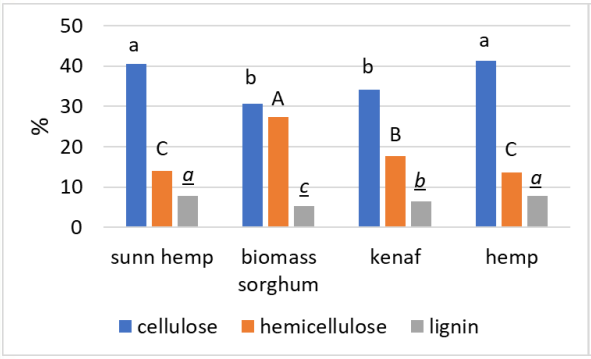
BIOMASS STEMS AND LEAVES COMPONENT

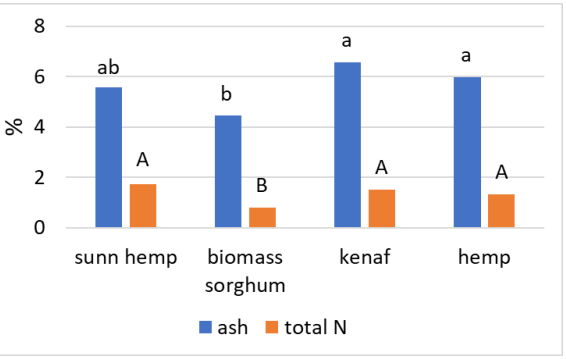


Continuous trendline: stems

Dot trendline: leaves

BIOMASS CHARACTERISTICS





Total carbon did not differ among varieties (average 46.5%)

MINERAL CONCENTRATION

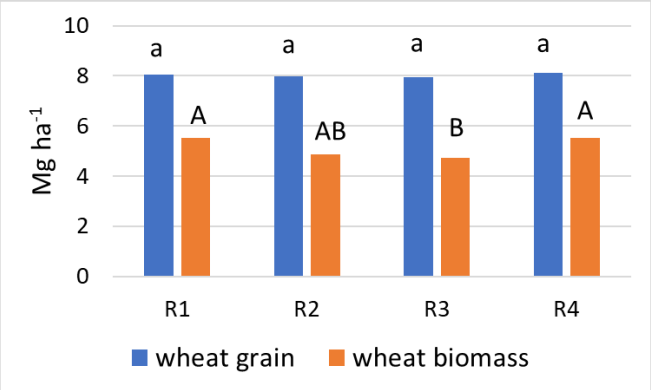
	Al	Ca	Fe	K	Mg	Na	P	S	Si	Si/K	Ca/K
Sunn hemp	28 a	7,487 b	43 b	10,465 a	2,073 b	233 ab	1,500 b	1,268 a	373 a	0.037 a	0.72 b
Biomass sorghum	15 a	2,332 c	31 b	5,087 b	2,141 b	92 b	1,124 b	729 b	210 bc	0.042 a	0.46 b
Hemp	43 a	11,192 ab	65 a	11,160 a	2,237 b	212 b	2,089 a	1,262 a	150 c	0.014 b	1.02 b
Kenaf	29 a	12,548 a	43 b	6,855 b	3,258 a	392 a	1,180 b	1,498 a	216 b	0.033 a	1.91 a

The mineral concentration is indicated as mg kg^{-1} db

Biomass sorghum and hemp have a general lowest and highest mineral concentration, respectively

Sunn hemp and kenaf show intermediate values

WHEAT GRAIN AND BIOMASS



R1 : sunn hemp – **wheat**

R2 : biomass sorghum - **wheat**

R3 : kenaf - **wheat**

R4 : hemp - **wheat**

CONCLUSIONS

- **Biomass sorghum** yielded up to **31 Mg ha^{-1}**,followed by **hemp** (**19 Mg ha^{-1}**), **sunn hemp** (**15 Mg ha^{-1}**) and **kenaf** (**10 Mg ha^{-1}**)
- **Biomass sorghum** showed the best suited feedstock characteristics of the lot with the **lowest ash**, **lignin** and **mineral content** compared to the other crops. It has also the **highest hemicellulose**
- **Sunn hemp**, **kenaf** and **hemp** might be more suitable to **biochemical conversion** pathway rather than thermochemical one due to higher ash and mineral
- **Wheat grain** production was similar among the tested rotation, whereas the straw in the **kenaf-wheat** rotation was significantly lower **(-3.5 Mg ha^{-1}**) compared to the straw produced in the **hemp-wheat** and **sunn hemp-wheat** rotations

Thanks for your attention

Andrea Parenti

Dept. of Agricultural and Food Sciences, University of Bologna

andrea.parenti5@unibo.it

www.unibo.it

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

www.becoolproject.eu
info@becoolproject.eu
@projectbecool

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