



# Enhance soil organic carbon stocks by means of the Biogasdoneright® system



Centro Ricerche Produzioni Animali

Mantovi P.<sup>1</sup>, Fabbri C.<sup>1</sup>, Valli L.<sup>1</sup>,  
Rossi L.<sup>2</sup>, Bozzetto S.<sup>2</sup>, Folli E.<sup>2</sup>,  
Hilbert J.<sup>3</sup>, Woods J.<sup>4</sup>, Thelen K.<sup>5</sup>, Dale B.<sup>5</sup>

<sup>1</sup> Research Centre on Animal Production (CRPA) - Italy

<sup>2</sup> Italian Biogas Consortium (CIB) - Italy

<sup>3</sup> Instituto Nacional de Tecnología Agropecuaria (INTA) - Argentina

<sup>4</sup> Imperial College London - UK

<sup>5</sup> Michigan State University - USA

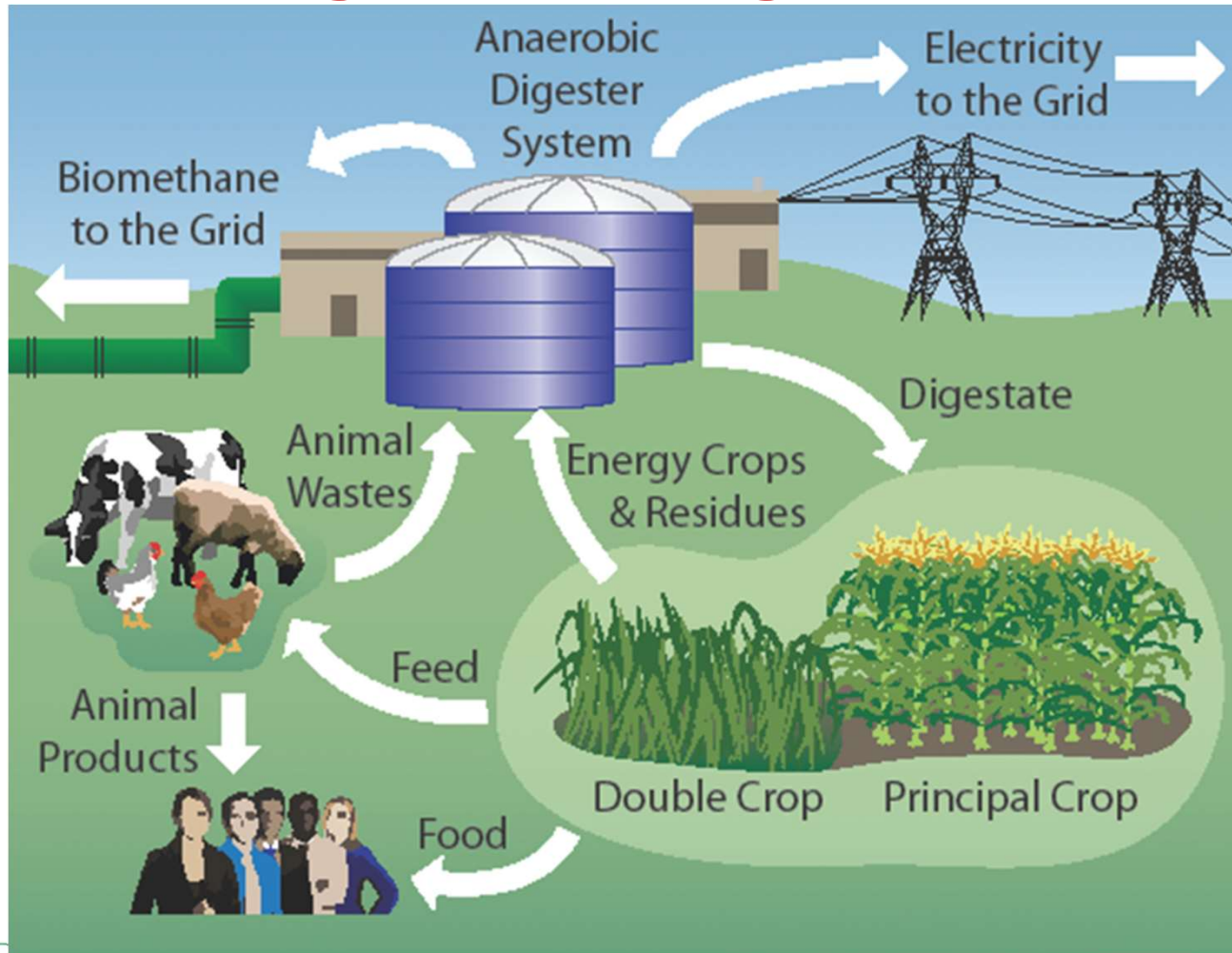
# The Biogasdoneright®

The Italian Biogas Consortium (CIB), assisted by an international panel of experts, developed an innovative agricultural model, with a platform of technologies aimed at achieving a sustainable agricultural intensification and called it Biogasdoneright® (BDR).

BDR produces renewable energy with positive environmental externalities, such as increased carbon content of soils, increased soil fertility and lower input of chemical fertilizers.

The BDR system is an example of multifunctional and sustainable agriculture according to “The Roadmap to a Resource Efficient Europe” (COM(2011) 571)

# The Biogasdoneright™ model



1. year-long cultivated soil with sequential cropping
2. efficient recycling of organic matter and nutrients
3. conservation tillage practices

# The key points of the BDR

- Farmers continue to produce traditional **food** and **feed** and also grow additional feedstocks to produce **fuel** via on-farm anaerobic digestion
- There is no “food versus fuel” issue. There is no mechanism for iLUC because food production continues as before
- Additional carbon is produced and part of that carbon is recycled (by digestate) and sequestered in the soil in highly stable forms
- Carbon losses as biogas are compensated by the lower carbon degradation after field application of the digestate and by the additional carbon fixed by the second crop, partly recycled as digestate

# Study case in a farm in the Po Valley



- Palazzetto farm (Cremona)
- Dairy farm with 300 milking cows
- 2 biogas plants (in total 1.6 MW electrical power)
- Cultivated area: 255 ha
- Rotation: feed and biogas annual crops
- Study based on hystorical and real data collected at the farm



# Assessing BDR sustainability

## Claims of the study:

- Sequential cropping leads to additional, low ILUC risk biogas feedstocks
- This additional production can be achieved while maintaining and enhancing soil quality
- Producing additional biomass for biomethane contributes positively to the decarbonisation of emissions
- Introduction of sequential cropping for sustainable farm is convenient and scalable

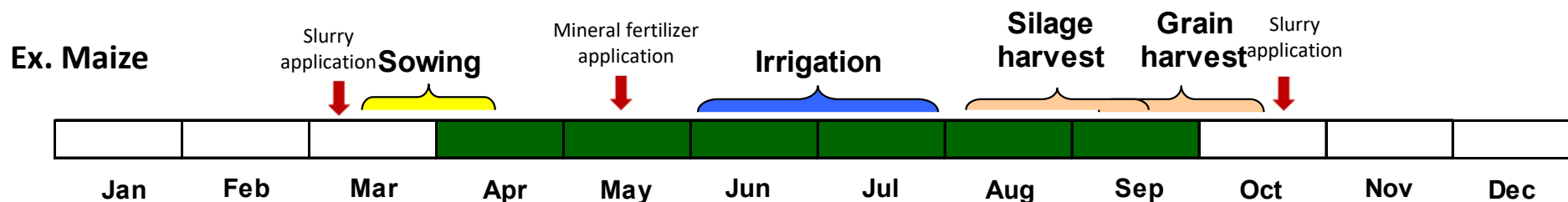


Assessing the case for sequential  
cropping to produce low ILUC risk  
biomethane  
Final report



# Conventional Agriculture

- Dairy farm, crop production to feed/food
- Arable crops, one-two crops per year (mainly maize)
- Fertilisation based on livestock manure + mineral

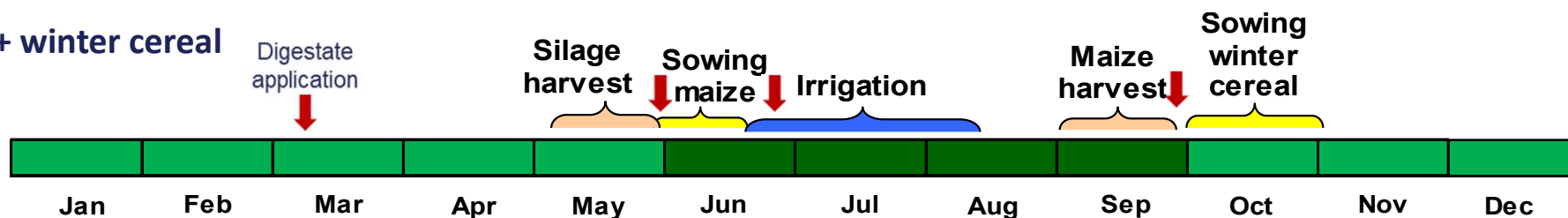


- ✓ Soil covered **6 months** per year
- ✓ Total above ground biomass around **23 DM t/ha/year (grain 13)**
- ✓ Irrigation: **necessary**
- ✓ Herbicides: **necessary**
- ✓ Soil tillage: **heavy (ploughing)**
- ✓ Organic matter level in soil: **steady or slightly down**

# BiogasDoneRight® concept

- Dairy farm, crop production to feed/food/energy
- Arable/no till crops, two crops per year (several)
- Fertilisation based on digestate

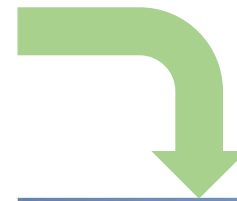
Ex. Maize + winter cereal



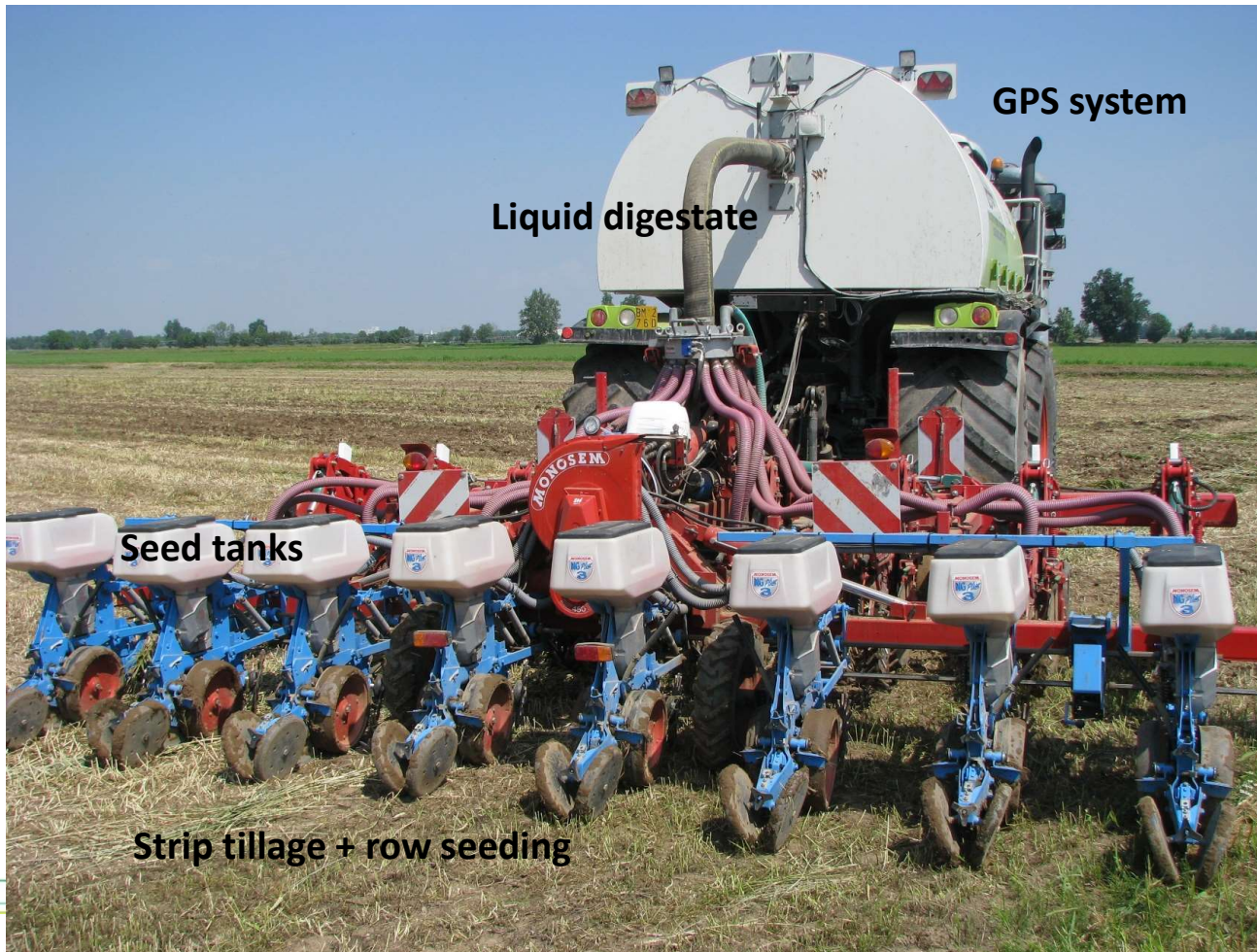
- ✓ Soil covered **12 months** per year
- ✓ Total above ground biomass around **30 DM t/ha/year (maize 18 + triticale 12)**
- ✓ Irrigation: **necessary**
- ✓ Herbicides: **reduced** (especially if agricultural work happens quickly)
- ✓ Soil tillage: **reduced**
- ✓ Organic matter level in soil: **increasing**



# Machinery for sequential cropping



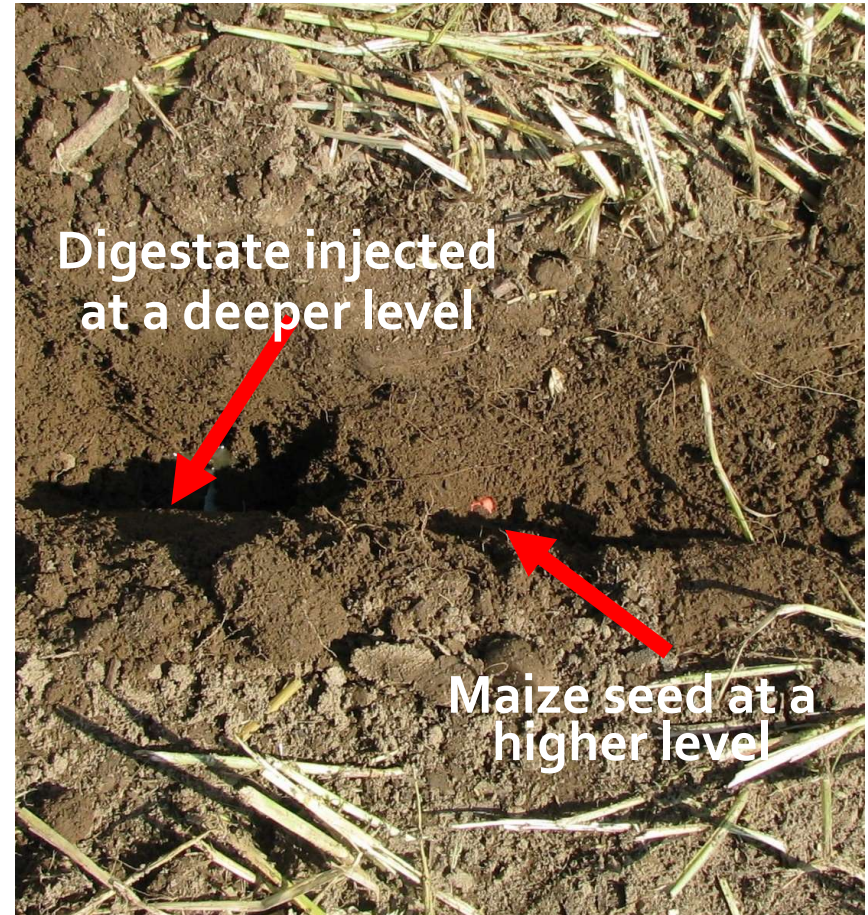
# Innovative machinery to reduce working time



Strip tillage, seeding and liquid digestate application at the same time

# High efficiency in digestate use

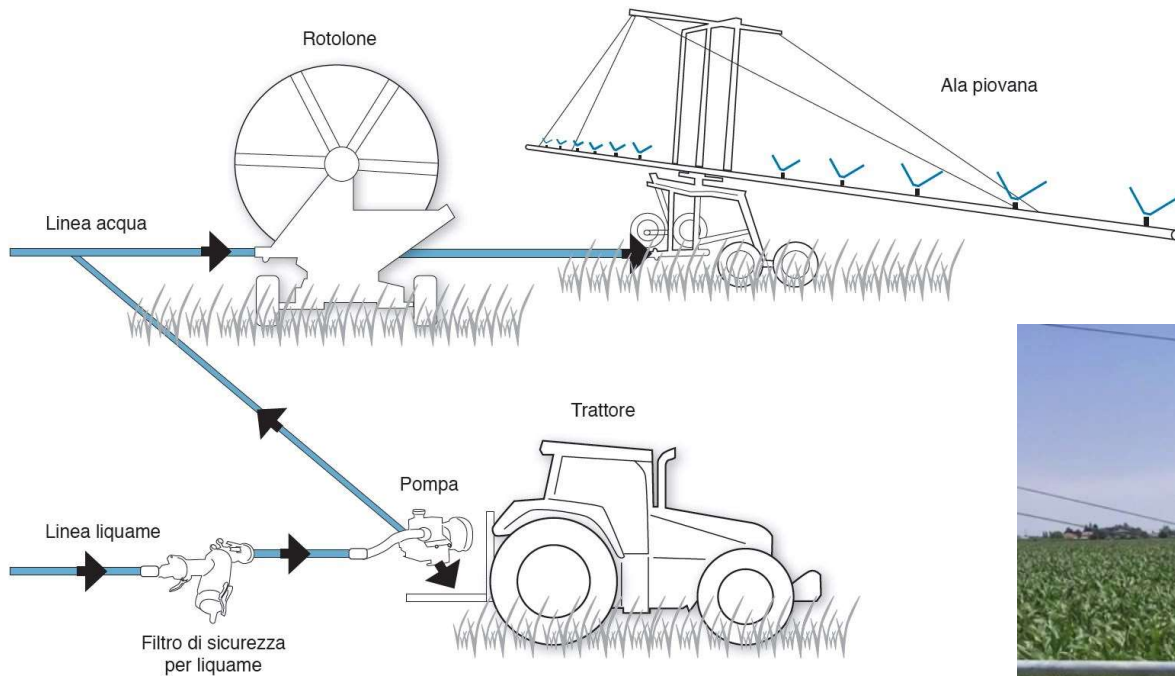
Maize seeding just after forage crop harvesting



# Fertigation with digestate

Digestate + water  
distribution with pivot  
irrigation system

Inter-rows distribution on  
growing maize

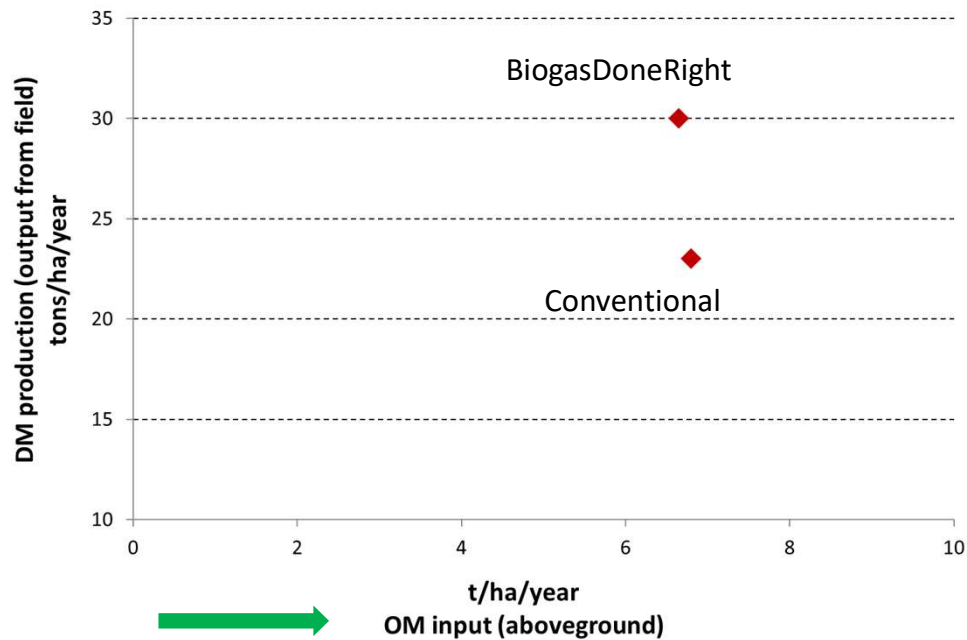


# DM production (above ground) and OM added

	DM Maize (t/ha/year)	DM Sequential crop (t/ha/year)	DM TOTAL (t/ha/year)	OM from effluents (t/ha/year)
Conventional	23		23	6.8
BiogasDoneRight	18	12	30	6.6

	Total Solids (%)	Total Nitrogen (%)	TKN / TS (%)	VS / TS (%)
Dairy cattle slurry	7.5	0.30	4.0	80
Digestate from cattle slurry + crops	8.0	0.48	6.0	72.5

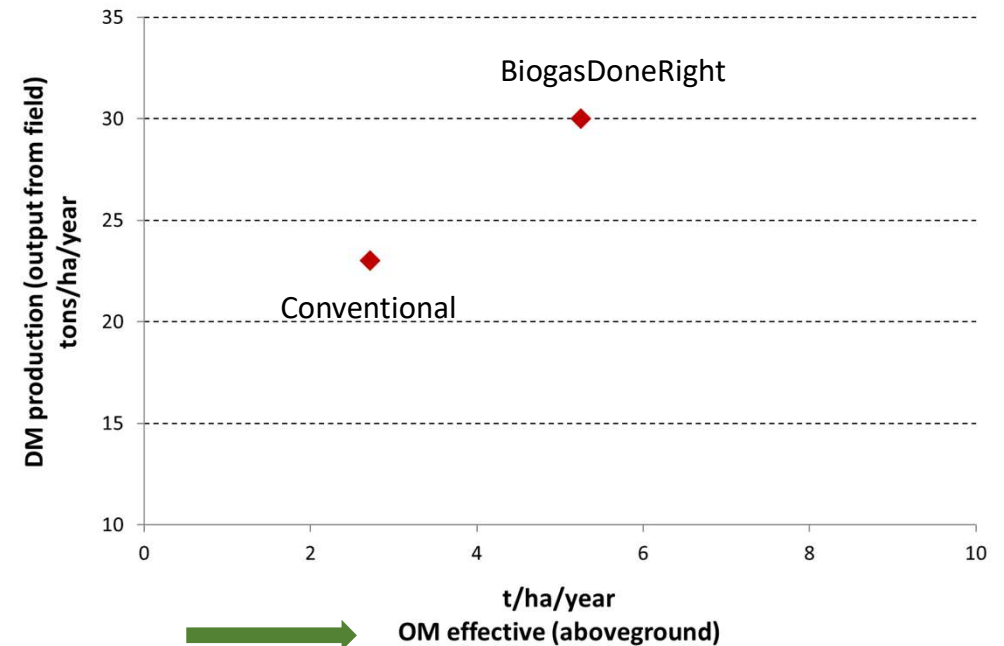
# OM to soil / DM produced



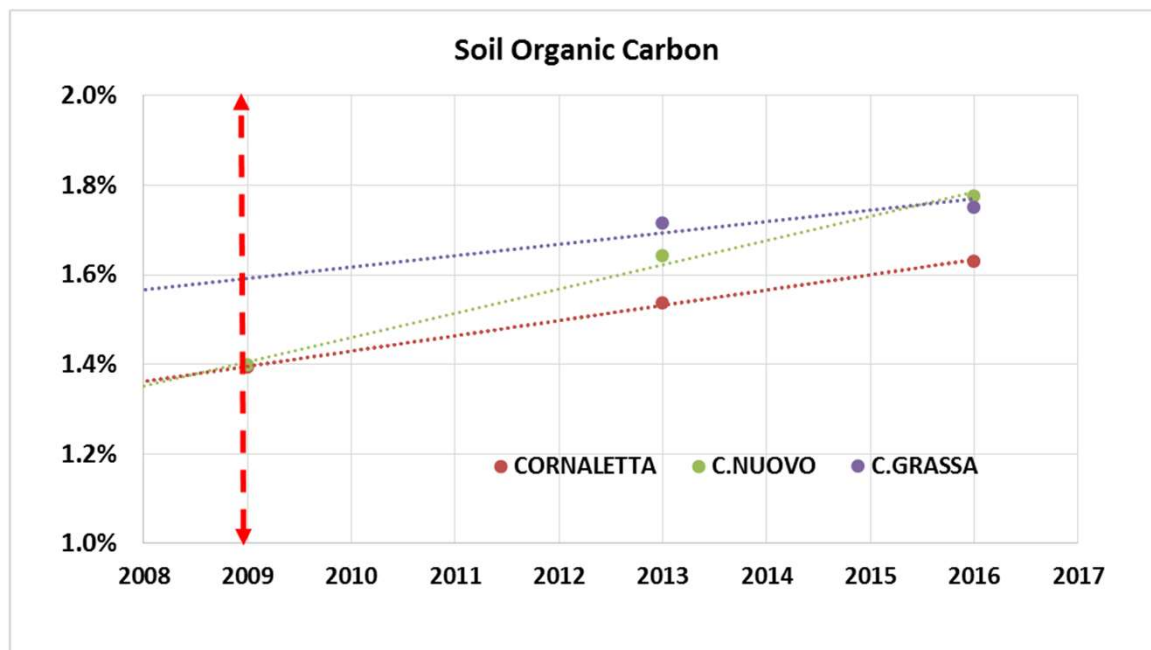
\* An., 2014. *Organische stof in de bodem*. Vlaamse Overheid, Departement Leefmilieu, Natuur en Energie, Brussel, B.  
 An., 2012. *Ecologische en economische voordelen van digestaat*.  
[www.inverde.be/content/kennis-gras/eindverslag-hoofdstuk4b\\_ecologische\\_en\\_economische\\_waardering\\_digestaat\\_Vlaco.pdf](http://www.inverde.be/content/kennis-gras/eindverslag-hoofdstuk4b_ecologische_en_economische_waardering_digestaat_Vlaco.pdf)

## Humification coefficients (kg C/kg C) \*

- Digestate from manure 0,79
- Cattle slurry 0,40
- Crop residues 0,21

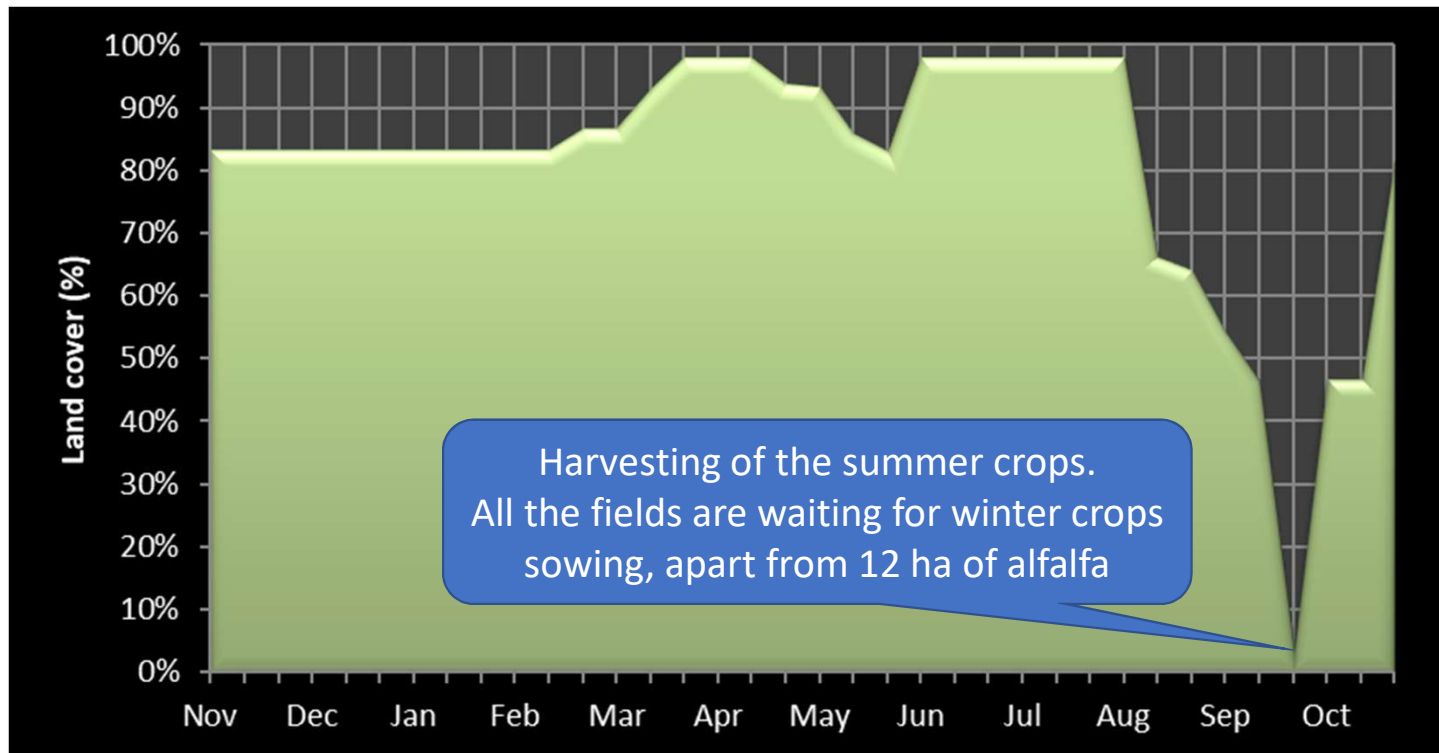


# Organic Carbon in soil



A mass balance approach was used to quantify the SOC change: field measurements of soil organic matter show an annual increase of SOC of 0.5 to 1.0 t C ha<sup>-1</sup> in the first ten years of BDR application, depending on various conditions, that is more than 10‰ per year

# Area of sequential cropping in the farm



About 59% of the farm land was covered for the whole year, with a very efficient control of weeds (lower herbicides treatments)



# Take home messages

- Compared to Conventional agriculture Biogasdoneright® is a new concept to maximise DM production and OM recycling (high quality) at the same time, together with mineral N savings
- BDR is a way for sustainable development in agriculture able to increase the SOC stock and to reduce the Carbon Footprint of farm products
- BDR is a work in progress model based on real farm experience
- More studies are needed in order to improve knowledge for a sustainable application in different areas and environment



*Thank you for your attention!*

*Laura Valli*

*Paolo Mantovi*

*[l.valli@crpa.it](mailto:l.valli@crpa.it)*

*[p.mantovi@crpa.it](mailto:p.mantovi@crpa.it)*