FERTILISATION, ROTATION AND THE USE OF ORGANIC MATERIALS

Introductory and first presentation fifth scientific session

EUVRIN workshop Fertilization and Irrigation

Almeria, 11 May 2017, Janjo de Haan

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Crop rotation and fertilisation

- Is crop rotation important? Why?
- How can crop rotation increase nutrient efficiency?
- Why is crop rotation not applied in all cases?
- What are research questions on relation crop rotation and fertilization?
- How can application of (well designed) crop rotations be extended?

Fertilization and the use of organic materials

- What are the benefits of using organic materials in fertilization?
- What are the risks of using organic materials?
- What are right application practices of organic materials?
- What are research questions on the use of organic materials in fertilization?
- How can right application practices of organic materials be extended to farmers?

Take Home Message

- Reduce leaching effectively?
  All farming measures have to be excellent!
  - Crop rotation
  - Pest & disease management
  - Soil management
  - Fertilization and irrigation
  - Marketing products
  - ...

→Stable growth, high yield, high nutrient uptake

- Optimization fertilization further than GAP small effect on leaching

When crop rotation is not your style: choose closed recirculating cropping systems

Content

- Importance of Crop rotation
- Concept op Effective organic matter to manage soil organic matter content

Illustrated by Farming Systems Experiment Vredepeel

Farming Systems Experiment Vredepeel

- Conventional & organic
- Arable, vegetable & fodder crops
- Combination of strategies for sustainable production
  - Excellent agronomy needed
- Focus
  - Crop protection 1989-2000
  - Nutrient management -2010
  - Soil management from 2010

Farming systems research *1989 2000*

2001

2003

2005

2008

Soil Quality on Sandy Soils *2011 2016*

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Crop rotation is a prerequisite for agro-ecological performance

- Reduce economic risks
- Increase soil fertility
  - More efficient use of fertilizers
  - Sufficient input of organic matter
- Decrease risks of pests and diseases
  - Reduced use of pesticides
- Decrease competition of weeds
  - Reduced use of herbicides
- Reduce labour peaks on farms

Crop rotation design

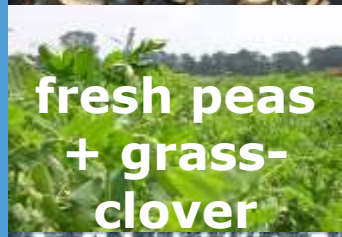
1. Crop selection
    - Environmental conditions and the farm context
    - Crop characterization
        - Economic, agronomic, morphological, ...
        - Main, secondary and tertiary crops
2. Crop sequence and crop frequency
    - Length of rotation and number of crops
    - Placing crops, choosing cultivation methods
3. Agro-ecological lay out
    - Field size, adjacency of crops

Crop rotation to enhance nutrient efficiency

- Improved yield
  - Generally higher yields in longer rotations
  - Improve soil conditions with right rotation
    - Organic matter input
    - Soil borne pests and diseases
- Improved nutrient recycling
  - N-uptake from mineralizing crop residues by catch crops and following crops

Crop rotation Vredepeel

- Choice of crops
  - Arable, vegetable and fodder crops
  - Combination of mow and root crops
  - Sensitivity for pests and diseases
- Transfer of nutrients
  - Crop residues
  - Green manure crops: Japanese oats
- N-fixation: leguminous crops
  - Peas
  - Grass-clover (10-11 months)

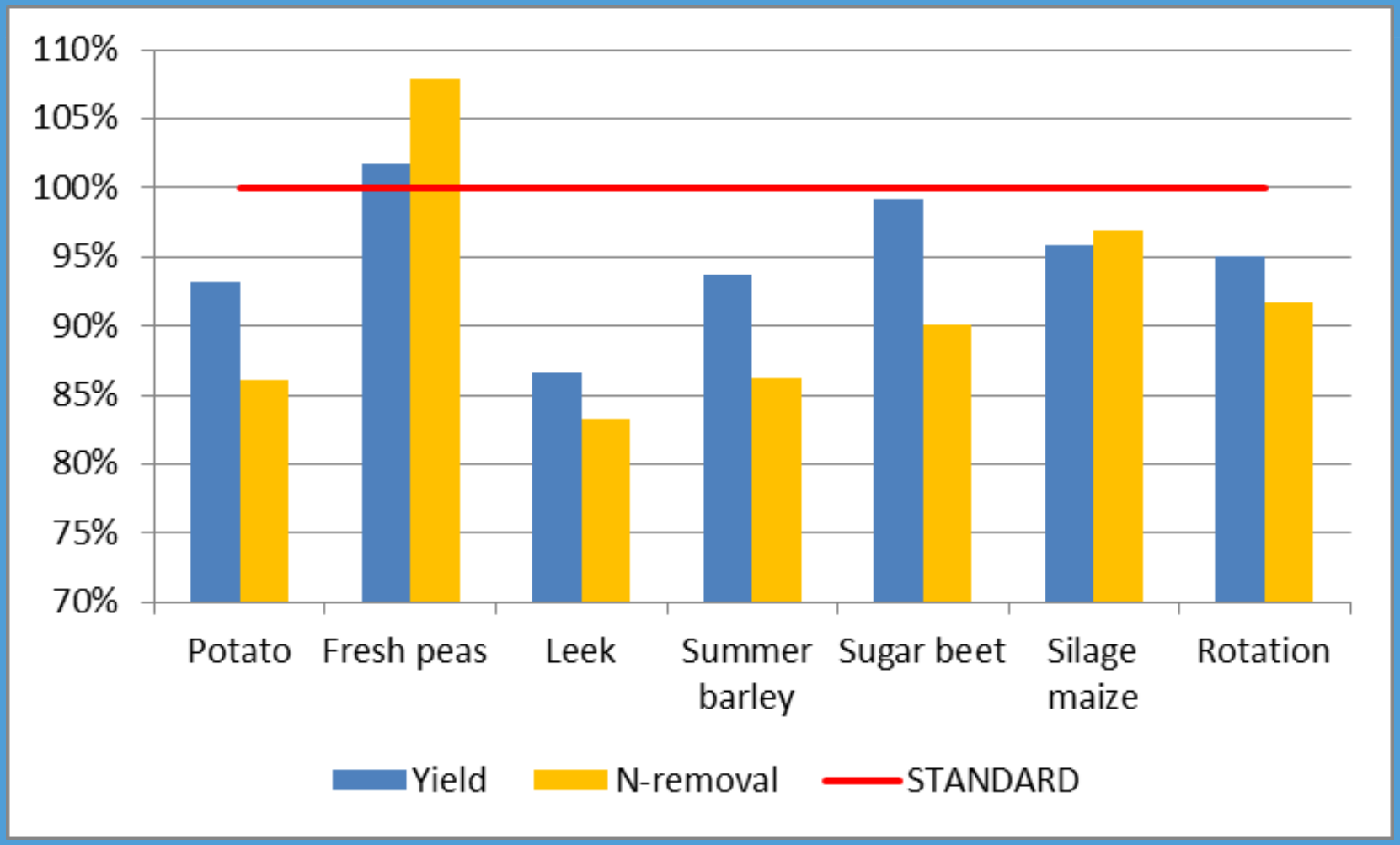


Reduction of nitrate leaching: Optimize the cropping system first

- Improving yields by improving other conditions
  - Pests/diseases, cultivation methods, soil
- Take up a catch crops
- Earlier harvest of main crop (improving catch crop)
- Other crops/cultivars in rotation
- Removal of N-rich crop residues
- Alternating shallow and deep rooting crops

- *Optimizing fertilization in many cases limited effect*
  - *Assumption: Good agricultural practices applied*

Effect of low organic matter input on crop yield and N-removal (2011-2016)



Organic inputs for soil fertility and crop production

- Internal
  - Crop residues and green manure crops
    - Defined by crop rotation
- External
  - Animal manure (slurry, solid)
  - Composts
  - Other organic waste streams
    - Sewage sludge, food processing waste

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Organic matter balance

Organic inputs

- **Crop residues**
- **Green manure crops**
- **Animal manure**
- **Composts**
- **Other inputs**

Decomposition of soil organic matter

NL: Average 2% per year = 1500-2500 kg organic matter per year

Effective organic matter (EOM)

- Is the organic matter from manure, compost, crop residues and green manures which remains one year after application.

Crop residues and catch crops	10-30%
Slurry and manure	30-70%
Compost	60-95%

- 1500-2500 kg/ha needed to compensate yearly SOM-decomposition

Effective organic matter input (EOM)

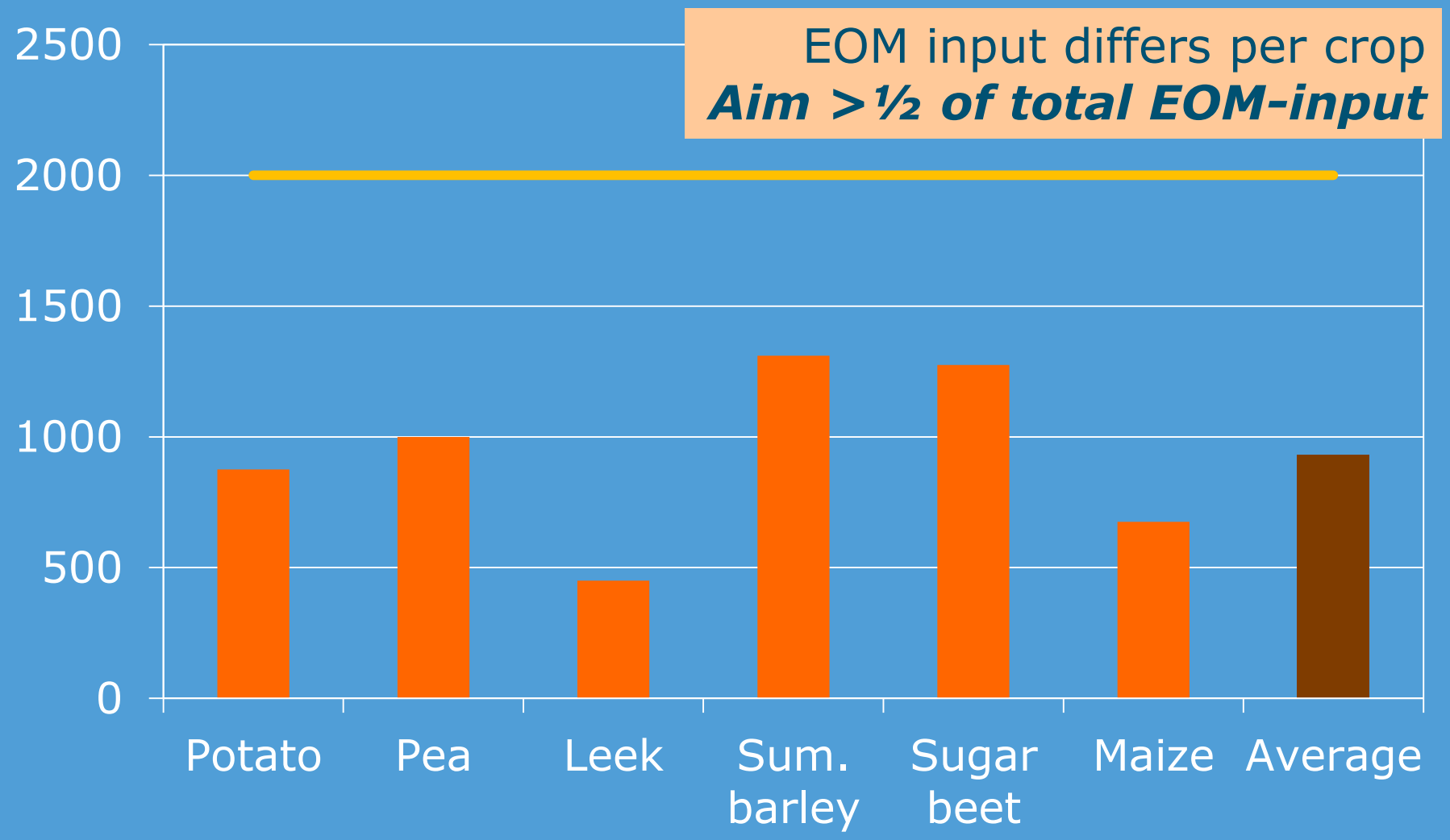
Crop residues and green manure crops (kg/ha)

- Cereals 1300-1700
- Cereals+straw 1900-2500
- Other crops 300-1300
- Grass 1 year 1200
- Grass 3 year 4000
- Green manure crops 800-1200

Manure and composts (kg/ton)

- Pig slurry 14
- Cow slurry 45
- Farmyard Manure 106
- Compost 182

EOM input crop residues



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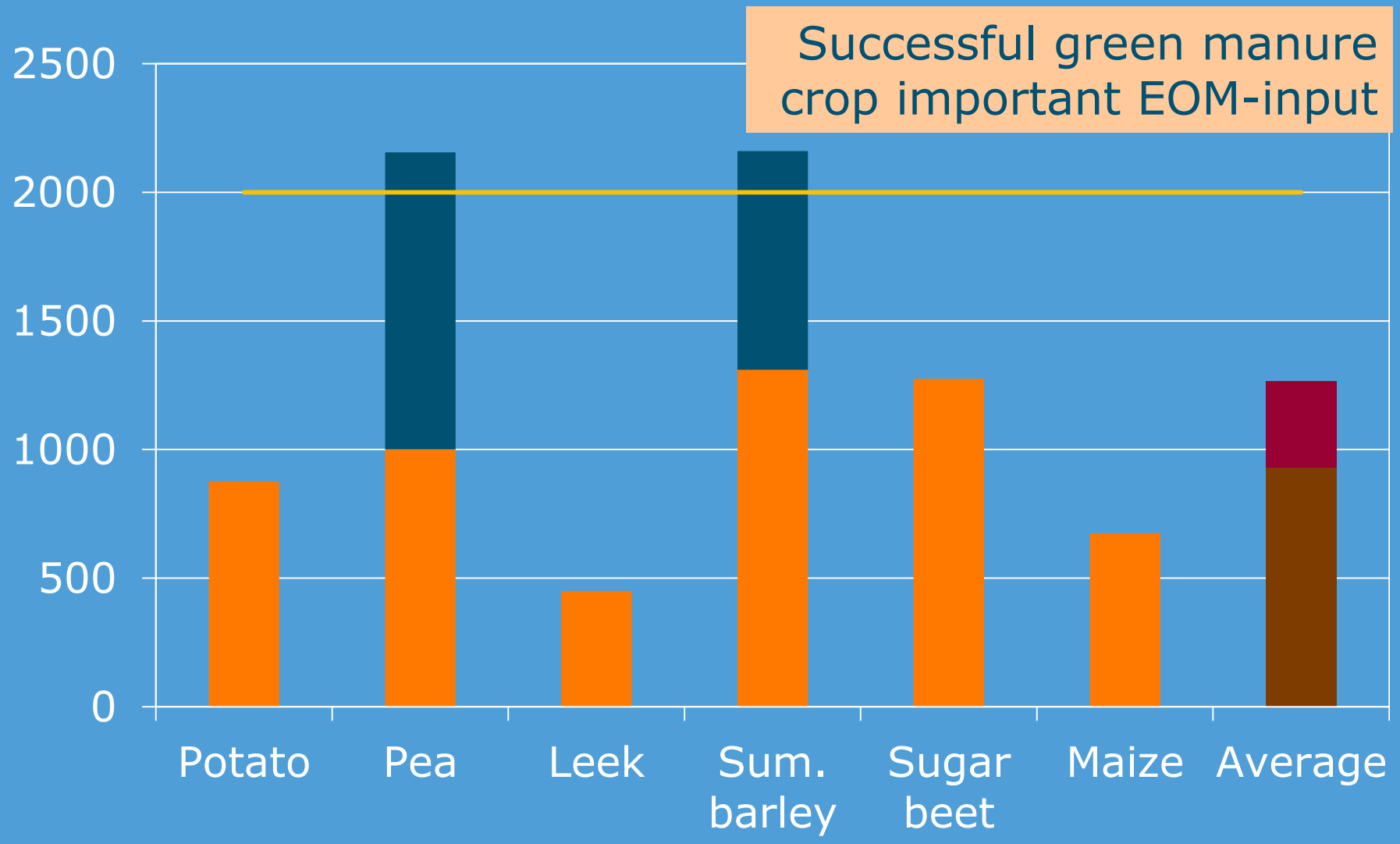
EOM input crop residues + green manure



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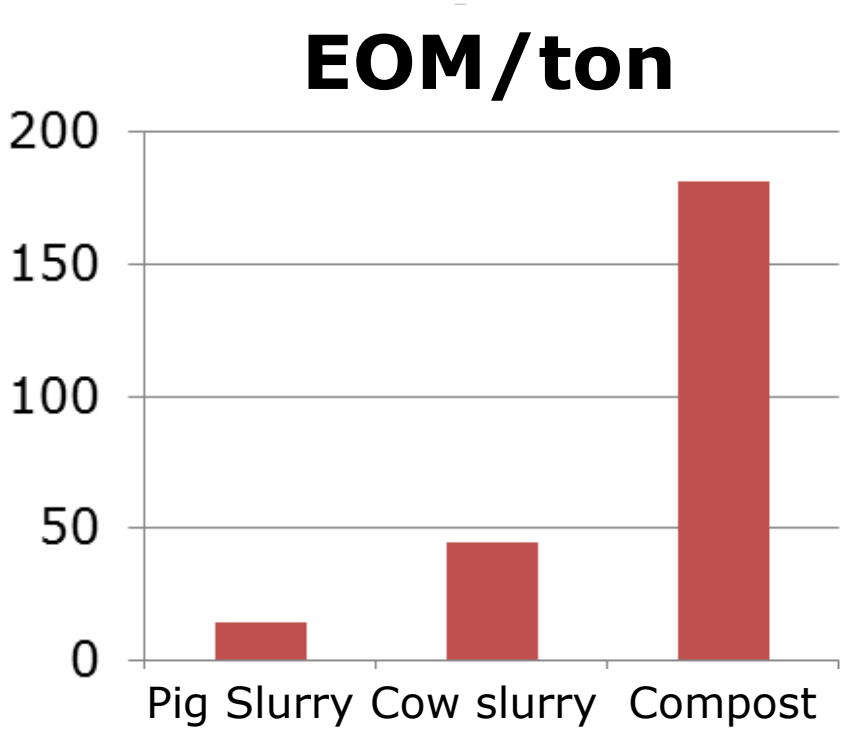
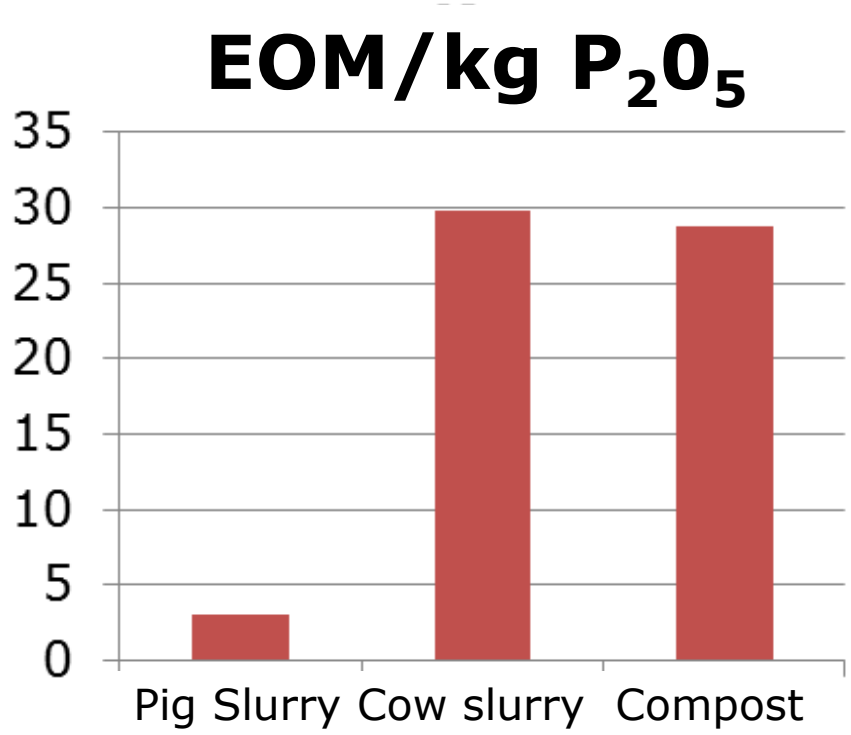
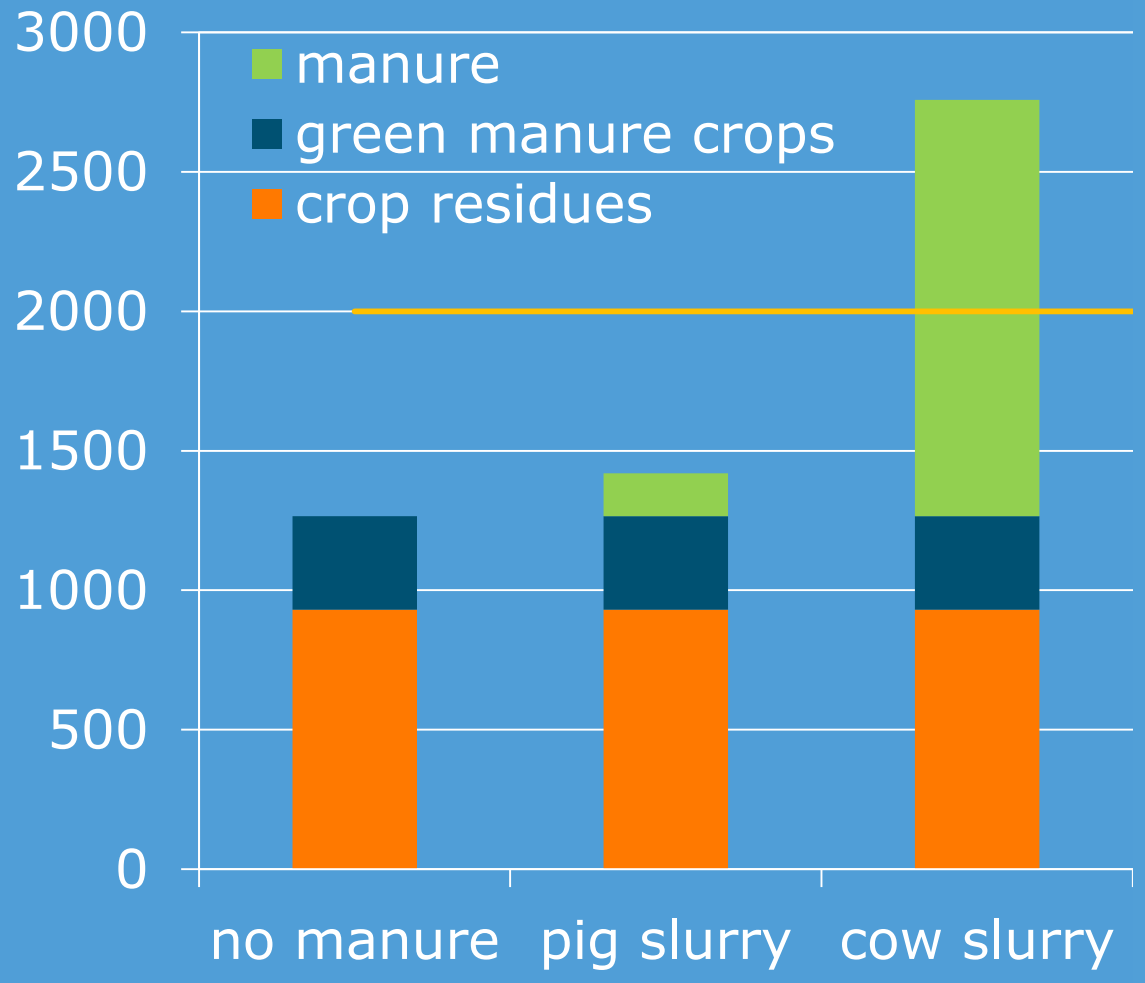
EOM input manure

Pig slurry low EOM-input
Cow slurry & compost high EOM-input



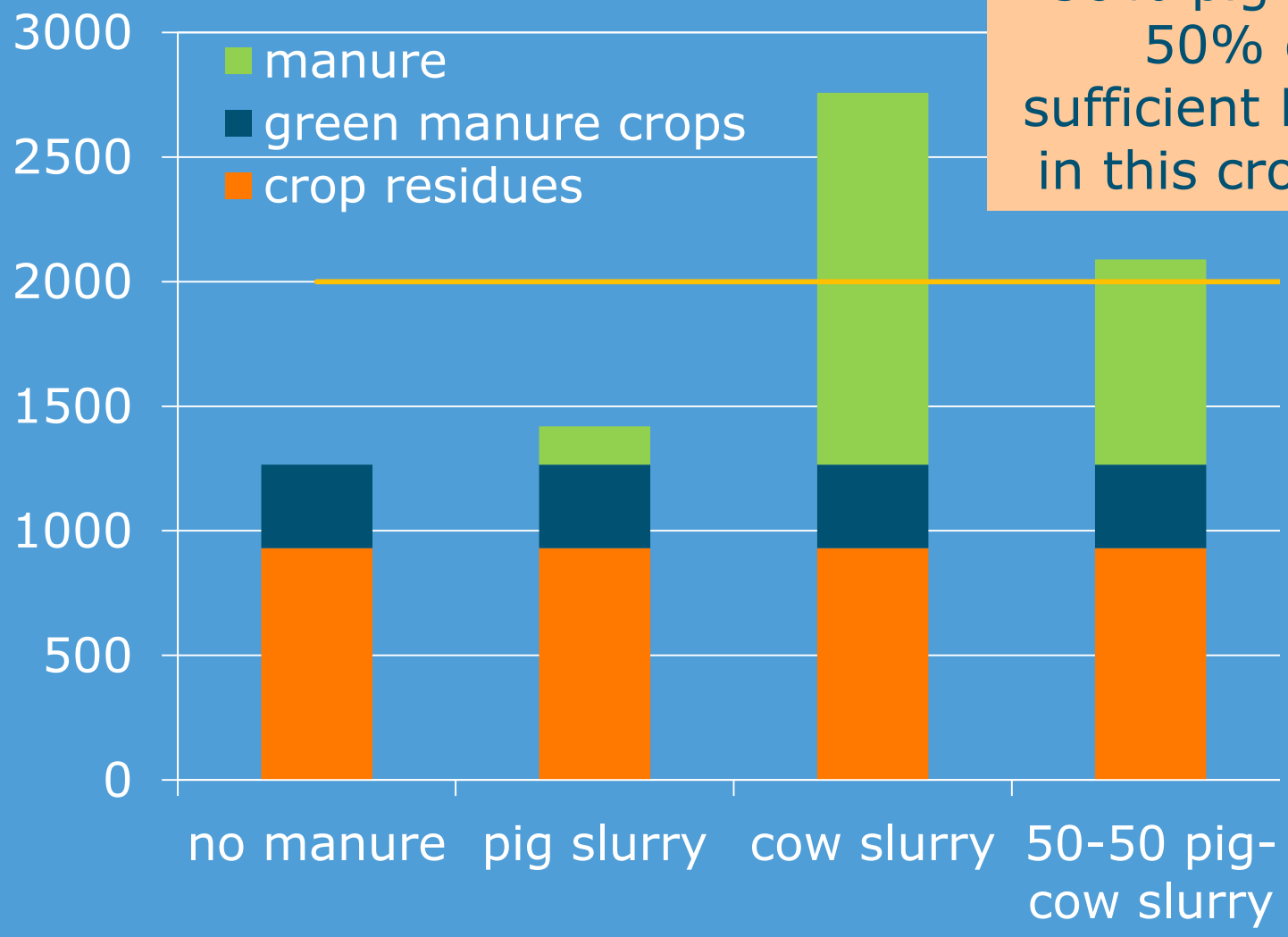


EOM input + manure (50 kg P_2O_5 input)



Pig slurry (VDM)
low EOM-input
Cow slurry (RDM)
high EOM-input

EOM input + manure (50 kg P_2O_5 input)



50% pig slurry and 50% cow slurry sufficient EOM-input in this crop rotation

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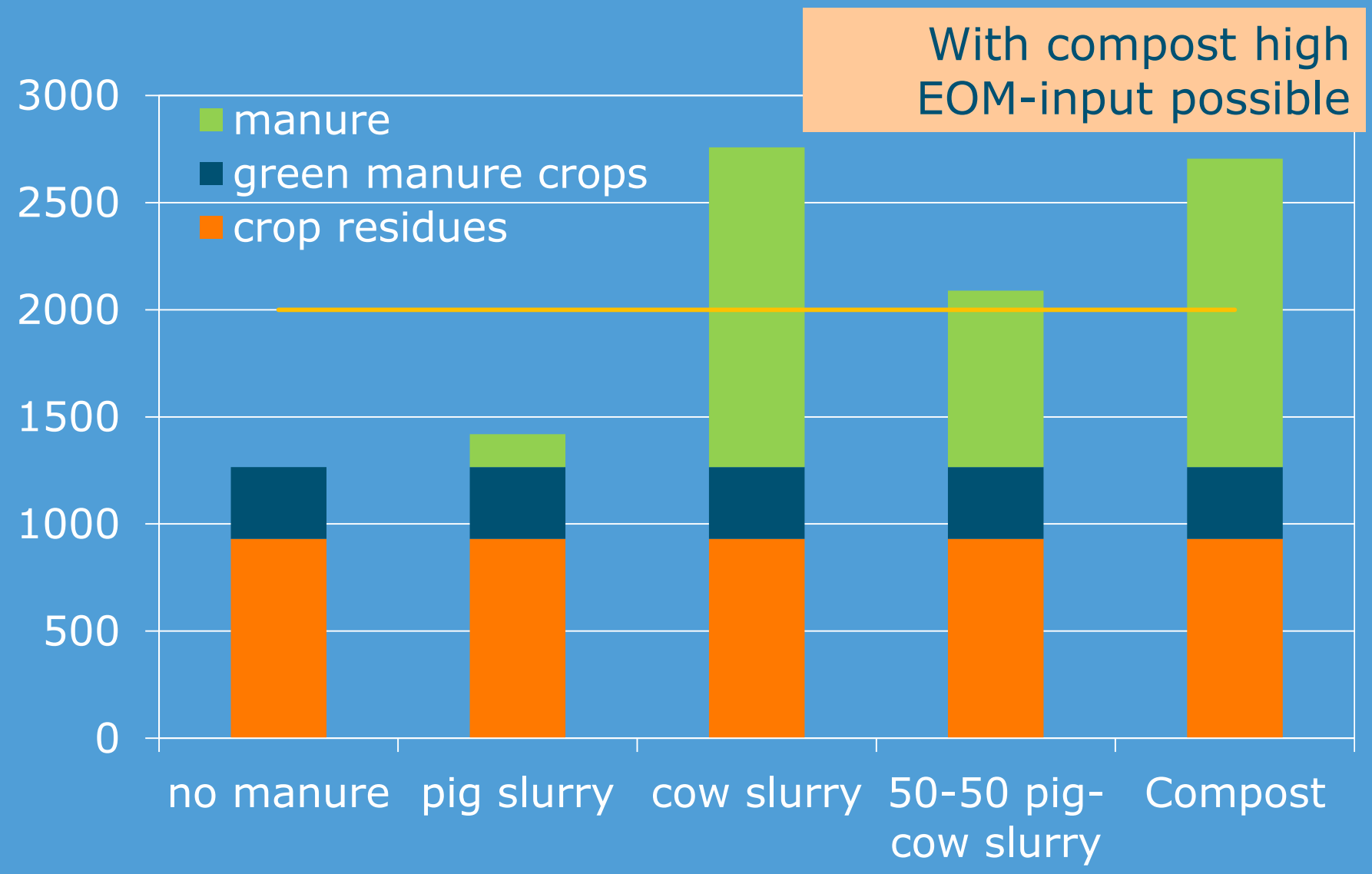
EOM input + manure (50 kg P_2O_5 input)



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Conclusions

- Smart crop rotation is the foundation for well performing cropping system
  - Improve yields, nutrient efficiency, ...
  - Reduce emissions, inputs, ...
- Effect smart crop rotation often larger than specific measures

- Effective organic matter simple concept for organic matter management
  - Update of key figures needed

When crop rotation is not your style: choose closed recirculating cropping systems