



# Conservation agriculture in Europe: impacts on soil function and crop productivity

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# Basic principles and theoretical impacts on ecosystem services & soil function

- Minimal soil disturbance
  - Increase soil C; enhance soil biological life
  - Improve soil physical properties
  - “Biological” tillage





# Basic principles and theoretical impacts on ecosystem services & soil function

- Maximum soil cover
  - Increase water infiltration and retention
  - Reduce soil erosion; improved water quality



# Basic principles and theoretical impacts on ecosystem services & soil function

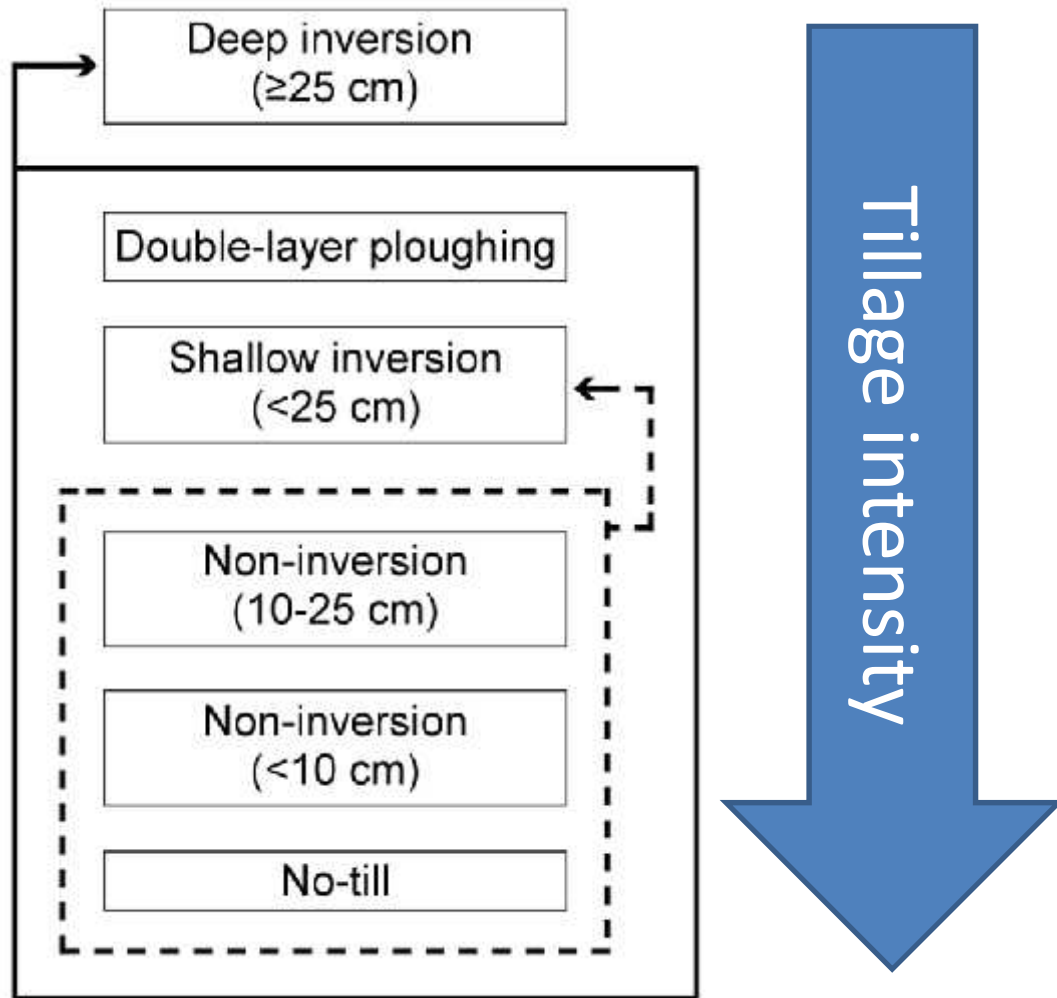
- Diversify crop rotations
  - Biodiversity in time & space
  - Breaks in pest cycles
  - Improved nutrient capture and recycling
  - Biological tillage by roots



# Challenges assessing scientific studies on CA

- System definition - reduced tillage/minimum tillage/direct drilling/zero till/no-till/conservation tillage – may all be used
- May not include complete package i.e. diverse rotations
- **Therefore it is difficult to draw conclusions about conservation agriculture in Europe based on existing experimental data**
- However, there are studies available comparing different levels of tillage intensity

# Understanding tillage intensity



# Impacts on crop yields – Pittelkow et al meta-analysis

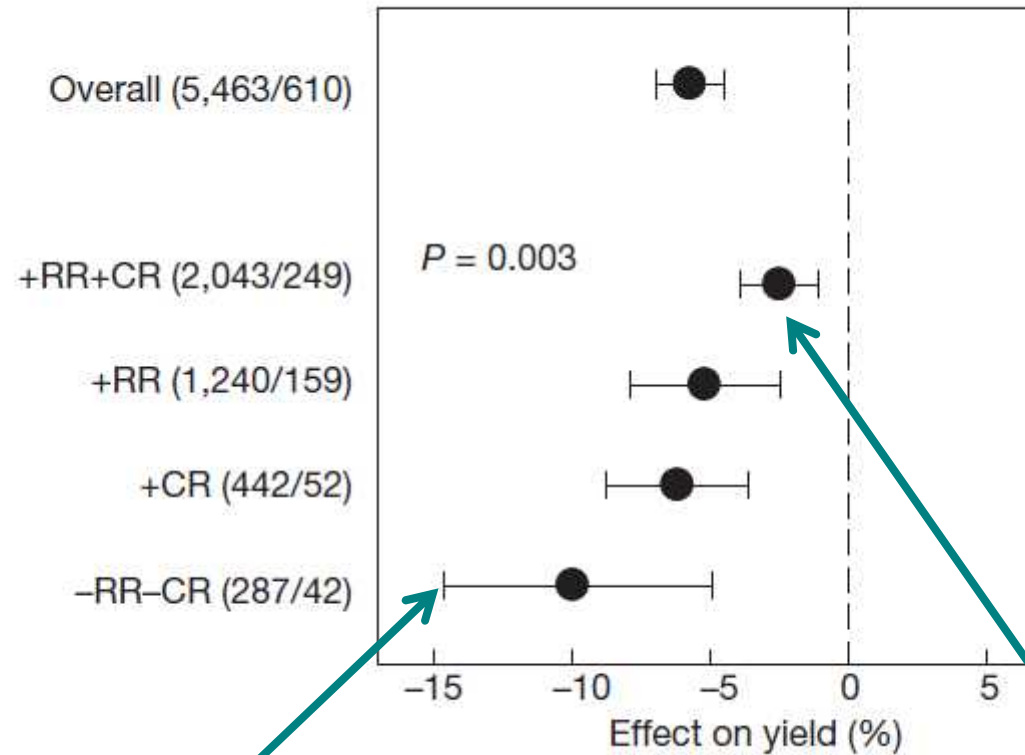
- Global meta-analysis; 5,463 paired yield observations from 610 studies
- Considering no-till with/without residue retention and crop rotation



Pittelkow CM et al. (2014) Productivity limits and potentials of the principles of conservation agriculture *Nature* 517:365-368 doi:doi:10.1038/nature13809



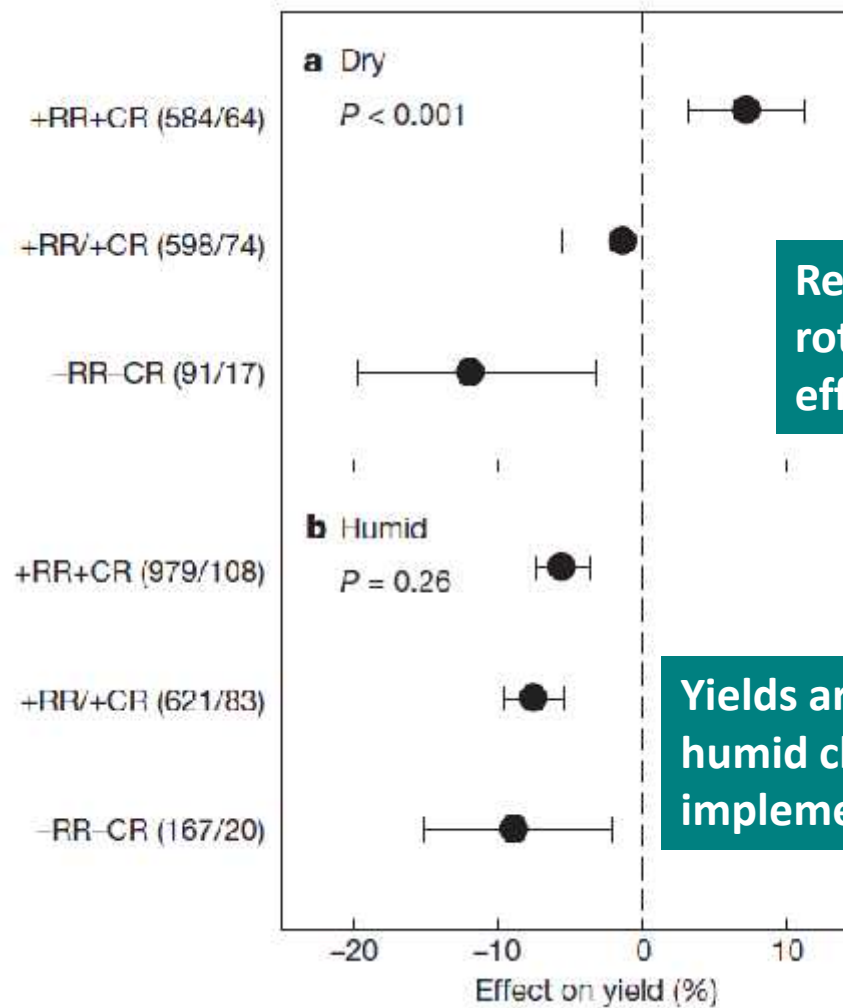
# Yield impact of conservation agriculture practices globally (Pittelkow et al. 2014)



Minimal yield reductions when no-till is combined with core CA principles of residue retention and crop rotation

Greatest yield reduction residue retention or crop rotation

# Yield impact of conservation agriculture practices dependent on climate (Pittelkow et al. 2014)



Residue retention and/or crop rotation neutral or positive effects on yields in dry climates

Yields are always slightly reduced in humid climates; even when full CA is implemented

# Why can yields in northern, humid climates be lower under conservation agriculture?

- Soil structure, especially on sandy soils
- Cool spring soil temperatures; inhibits nutrient supply (especially in spring)



Min till + compost

Conv till + compost

# Additional challenges in organic systems

- Weed control!!
- Need to incorporate soil-building leys without herbicides
- Incorporation of manures & composts
- Occasional “strategic tillage”?
- Destruction of cover crops

# Roller crimper for organic destruction of cover crops



## Concluding comments/research needs

- Multiple ecosystem services from CA practices
- Challenges with implementation in some climates (cool, humid) and systems (organic)
- Need for development of appropriate technologies (seed drills, roller crimpers)
- Adaptation of the system to local conditions/strategic tillage may sometimes be appropriate

Thanks and questions?

