

# Effect of pure biochar additions on crop yield in 32 European field trials



Greet Ruyschaert

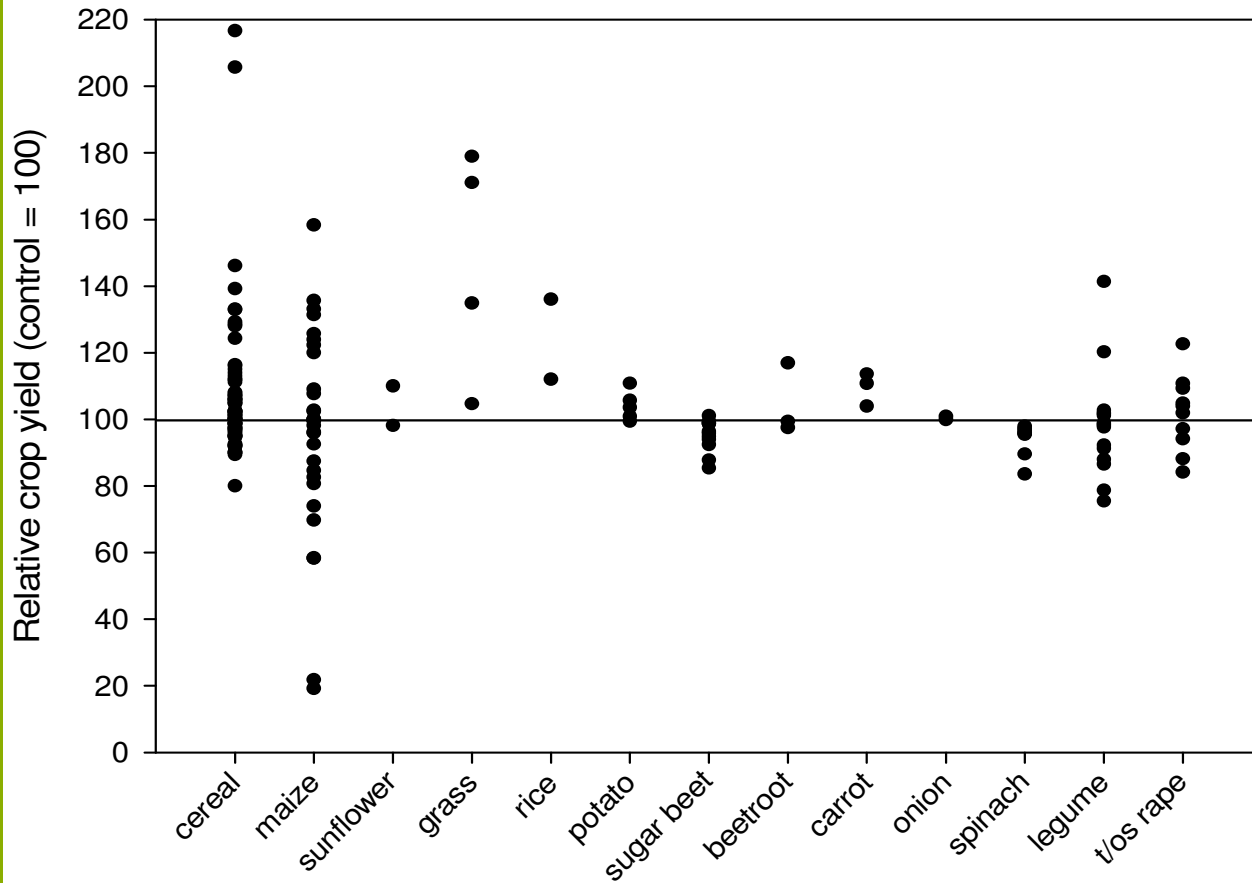
Final meeting EU-COST action "Biochar"  
Geisenheim (DE), 28-29/09/2015




**ILVO**  
Institute for Agricultural  
and Fisheries Research

# 32 biochar field trials

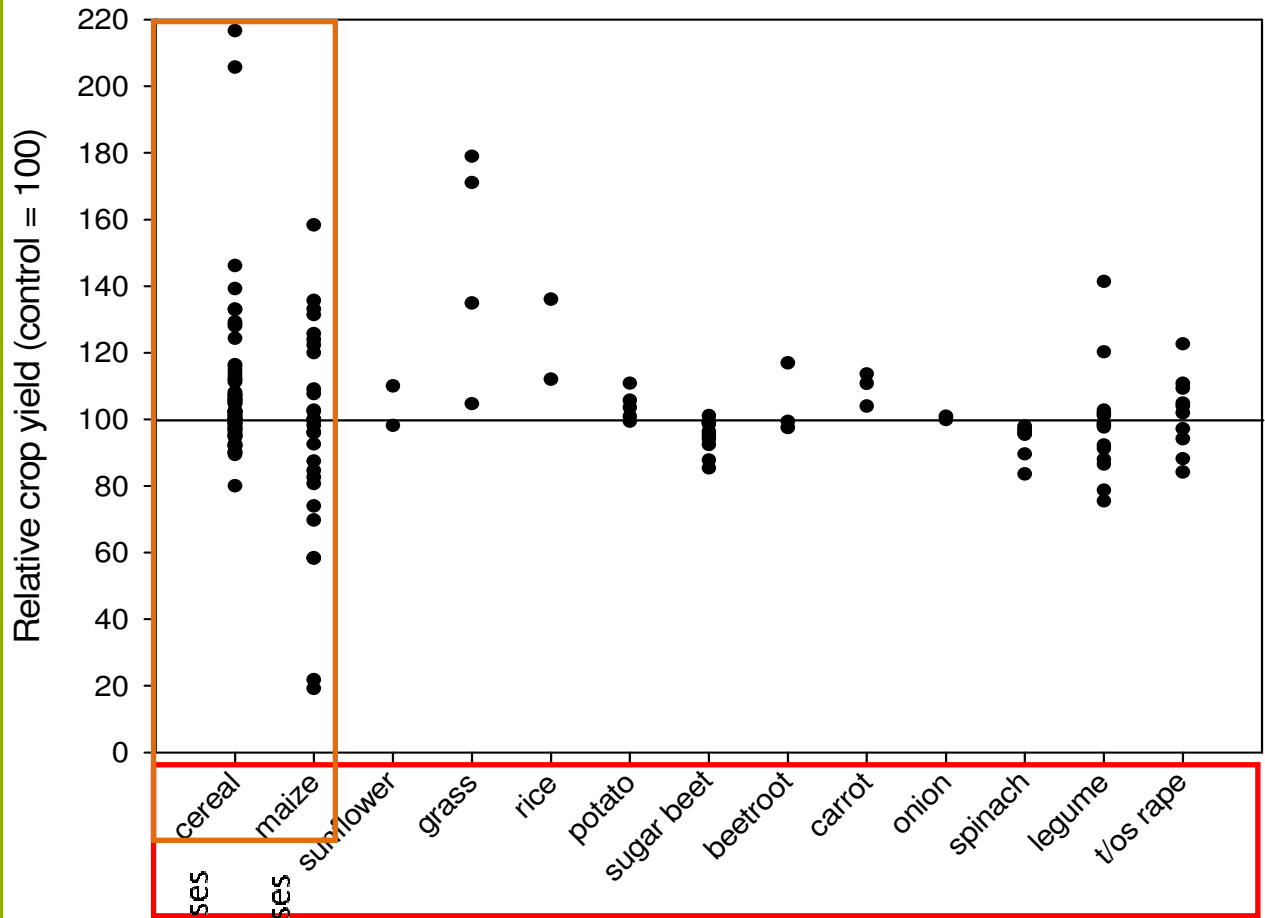
- Pure biochar additions (vs unamended plots)
- 32 sites in Europe
  - North-West: Norway (2), Sweden (3), Finland (3), Denmark (2), the Netherlands (3), Belgium (1), Germany (5), UK (7)
  - Central: Austria (2)
  - South: Italy (4)
- 75 location - biochar type – biochar dose combinations
- 171 location – biochar type- biochar dose – year combinations
- $\leq 4$  monitoring years after addition
- Coarse to moderately fine soil textures
- Mainly wood-based biochars
- Mostly slow pyrolysis – traditional charcoal industry

# Yield response



-  80% of cases ( $p > 0.05$ )
-  12% of cases pos. effect
-  6% of cases neg. effect
- 2% of cases unknown

# Crop type



## Cereals

😊 23% of cases ( $p < 0.05$ )

😞 3% of cases

## Maize

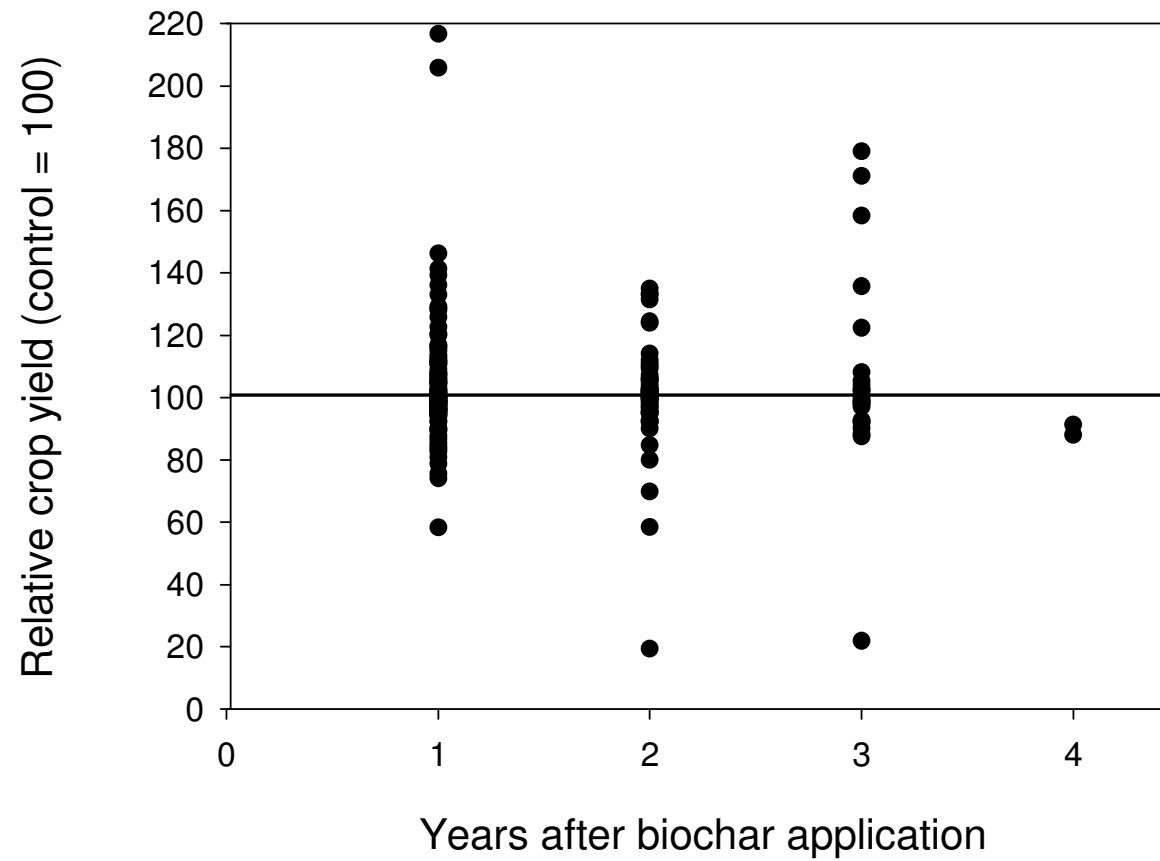
😊 0% of cases ( $p < 0.05$ )

😞 17% of cases

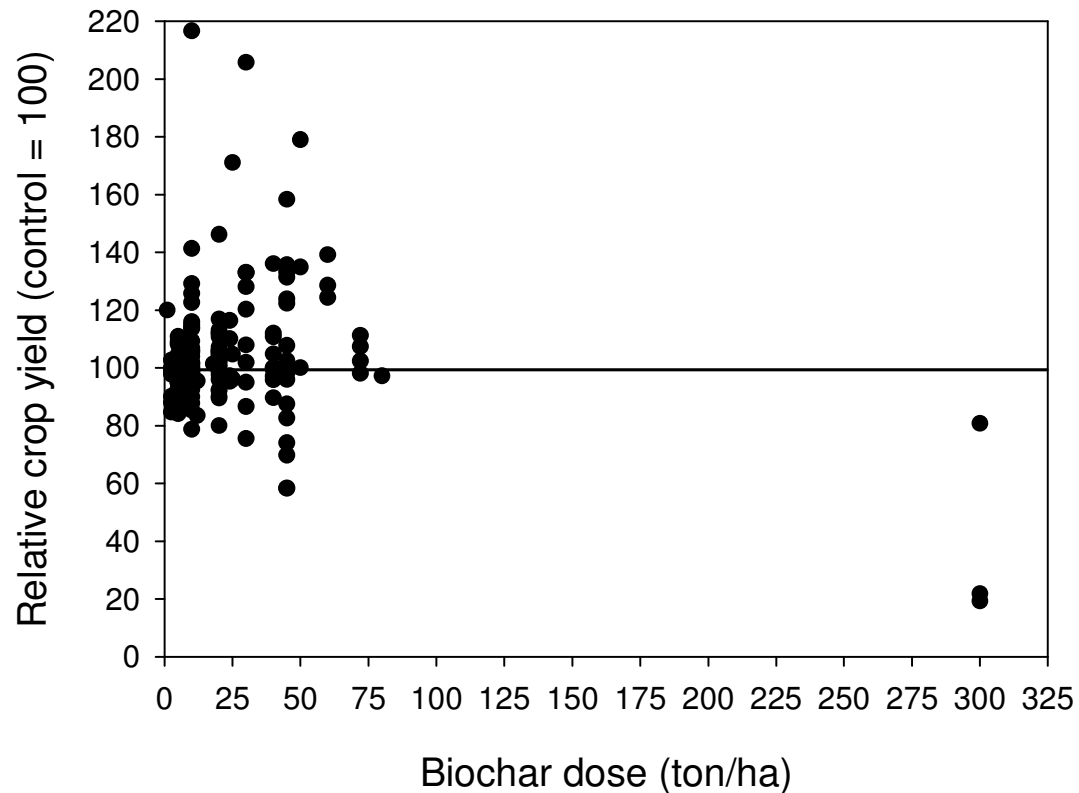
# Time after applications

- Short-term hypotheses
  - 😊 liming agent, effects on nutrient availability, nutrients in ash fraction  
=> *less important in sufficiently limed and fertilized EU soils?*  
effects of chemical compounds
  - 😞 reduced soil mineral N contents, phytotoxic effects  
=> *apply some months before sowing?*  
=> crop yields in the first year after spring application:  
mostly: biochar = or > control  
some neg. effects with flash pyrolysis and hydrochar
- Long-term hypotheses
  - 😊 higher CEC

# Time after applications



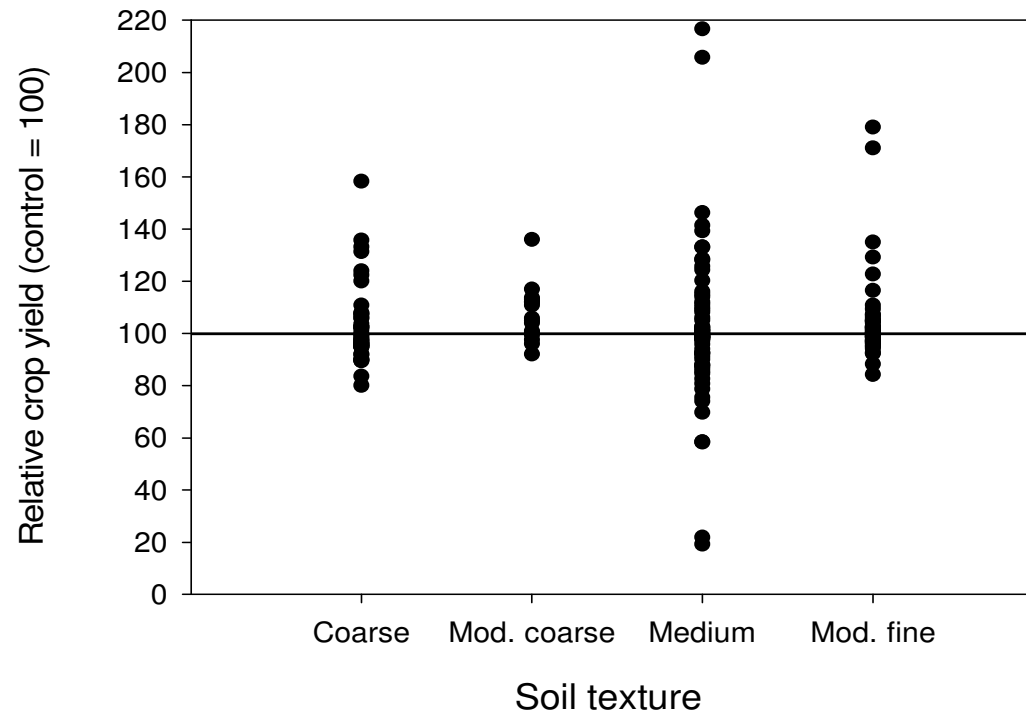
# Biochar dose



- 2.5-300 ton biochar/ha
- Mostly 1 time applications
- Some pos. effects at low doses (10 ton/ha)
- Some neutral or pos. effects at high doses (40-90 ton/ha)
- Risk for yield reductions at very high rates (300 ton/ha)

# Soil texture

Hypothesis: positive crop response in coarse and medium textured soils (Jeffrey et al., 2011)





# Research gaps + Conclusions

- More trials needed
  - in central and southern Europe
  - with non-woody biochars
- Field trials should be maintained longer
- Pure biochar additions: less potential in fertile soils and already optimised farming in Europe - in the short term

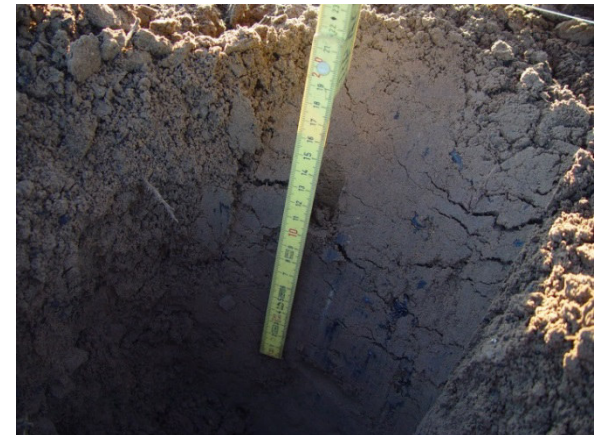
=> Ways forward:

Combining with other (organic) fertilizers?

Use it in composting processes? Animal feeding?

Use biochar in niche applications?

Tackle site-specific problems (e.g. drought)



- Better mechanistic understanding biochar properties vs functioning needed

## Source:

Ruysschaert G., Nelissen V., Postma R., Bruun E., O'Toole A., Hammond J., Rödger M., Hylander L., Kihlberg T., Zwart K., Hauggaard-Nielsen H., Shackley S. (in press): Chapter 5: Field applications of pure biochar in the North Sea region and across Europe. In: **Biochar in European Soils and Agriculture** (Shackley S., Ruysschaert G., Zwart K., Glaser B. eds). Routledge, Abingdon.

Institute for Agricultural and Fisheries Research  
Merelbeke – Belgium  
[greet.ruysschaert@ilvo.vlaanderen.be](mailto:greet.ruysschaert@ilvo.vlaanderen.be)  
[www.ilvo.vlaanderen.be](http://www.ilvo.vlaanderen.be)

# Acknowledgements

- Interreg IVB North Sea Region project “Biochar: climate saving soils”
- EU COST-Action “Biochar”
  
- Jasmin Karer and Gerhard Soja (Austrian Institute of Technology)
- Gerard Ros and Romke Postma (NMI, the Netherlands)
- Nils Borchard (Rheinischen Friedrich-Wilhelms-Universität Bonn, Germany)
- Claudia Kammann (Geisenheim University, Germany)
- Kerstin Panten (Julius Kühn-Institut, Germany)
- Priit Tammeorg (University of Helsinki, Finland)
- Sara Buckingham (Scotland’s Rural College, UK)
- Esben Bruun and Henrik Hauggaard-Nielsen (Riso DTU, Denmark)
- Adam O’Tool (Bioforsk, Norway)
- Jim Hammond and Simon Shackley (University Edinburgh, UK)
- Markus Rödger and Achim Löwen (HAWK, Germany)
- Tor Kihlberg and Lars Hylander (Sweden)
- Kor Zwart (WUR, the Netherlands)
- Victoria Nelissen (ILVO, Belgium)