Biochar as yield promoter for agricultural crops? Conjectures and observations

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Content

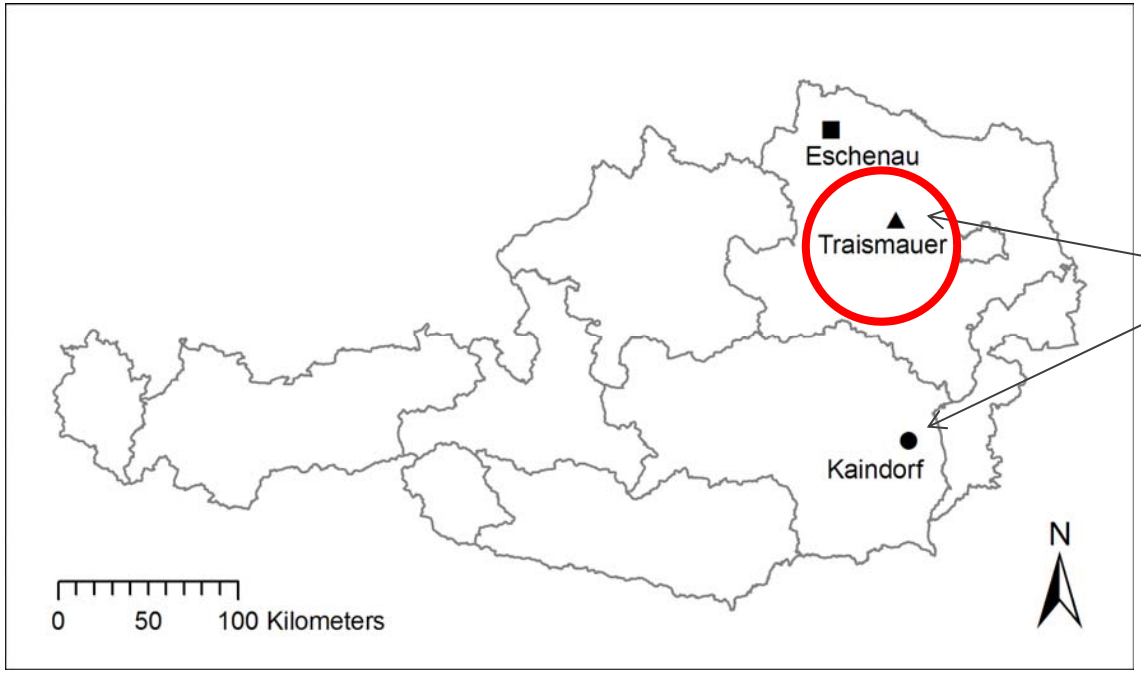
- Biochar field experiments in Austria
  - Focus on **crop yields**:
    - Site Traismauer
    - Site Kaindorf
- **General conclusions** from field and pot experiments for crop productivity

European biochar research sites in 2012 (COST database, in progress)

Field experiments in Austria
(just 2 of them)

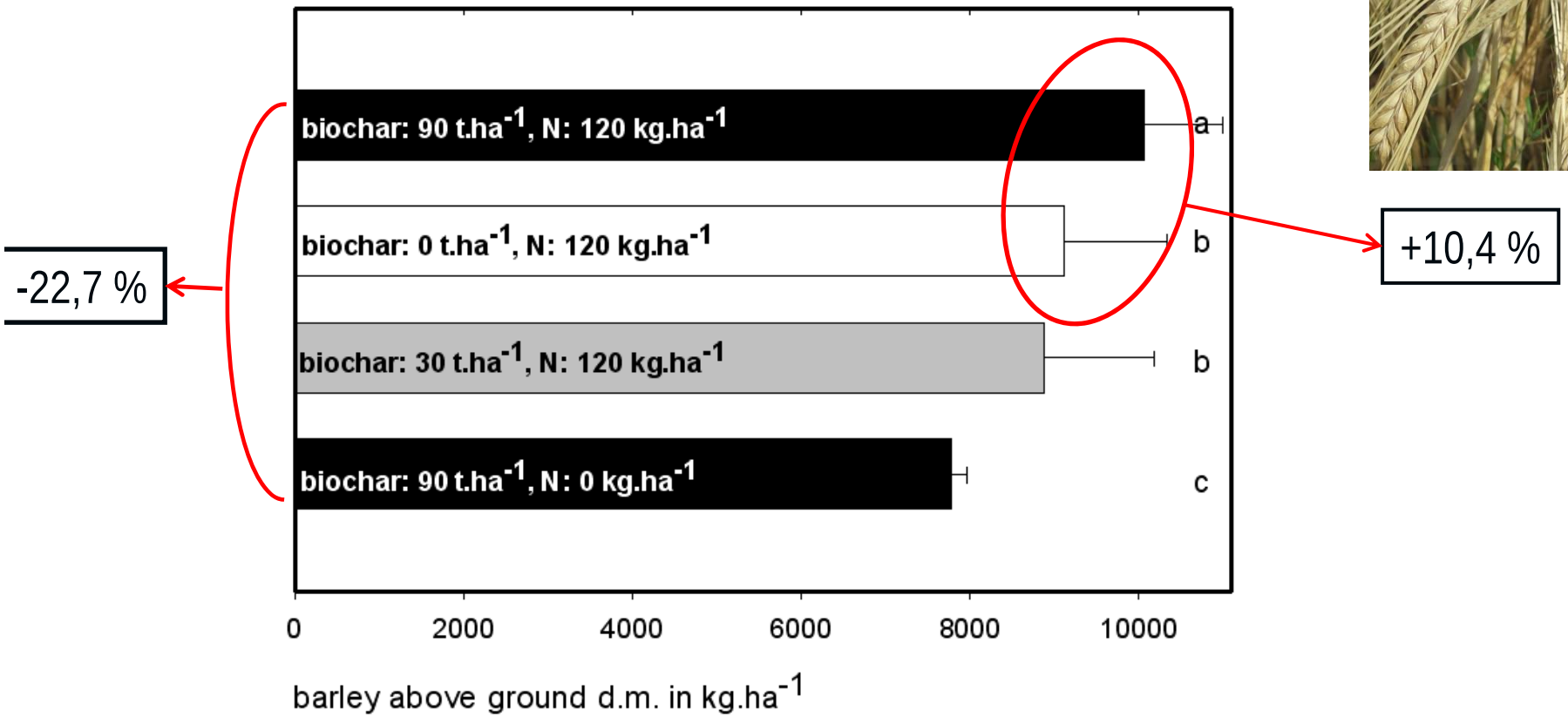
Installation of field experiments:
4 x 4 Latin square at each site
each gross plot: 33 m² , each net plot: 10 m²

Crop experiments with biochar in the field: Site **Traismauer**



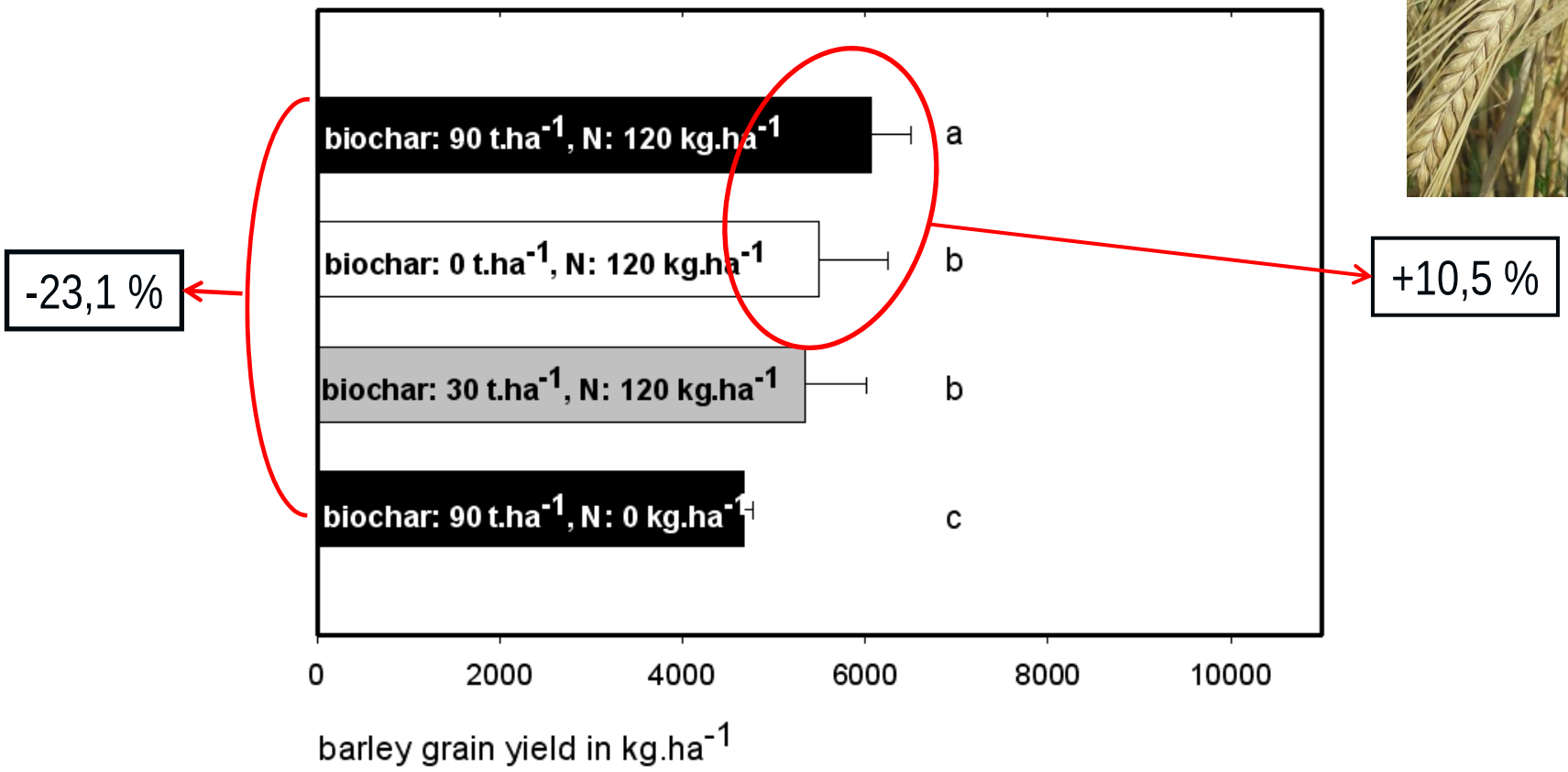
Locations of field experiments

Field experiment Traismauer spring barley 2011: above-ground dry matter (d.m.)



biochar = RomChar (wood-based charcoal)

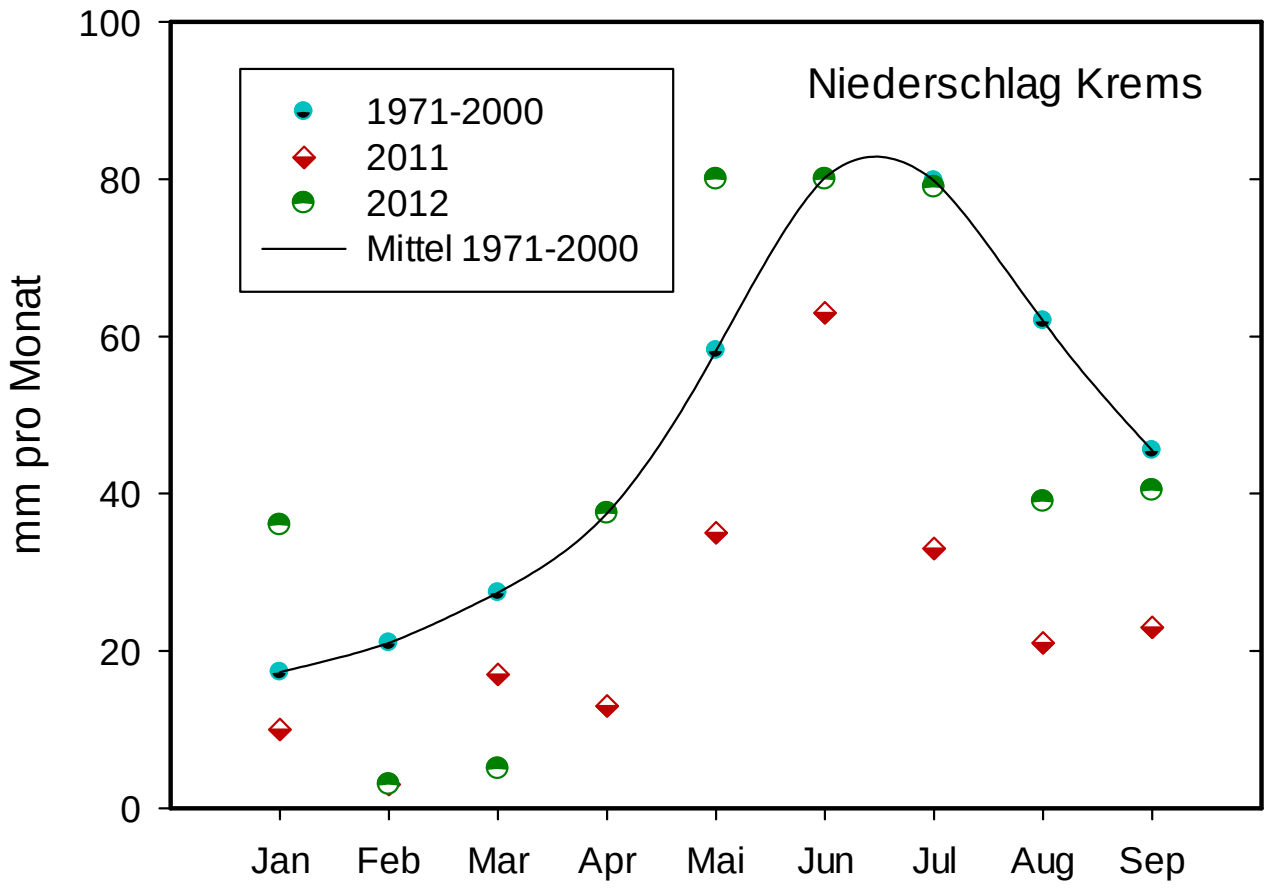
Field experiment Traismauer spring barley 2011: grain yield



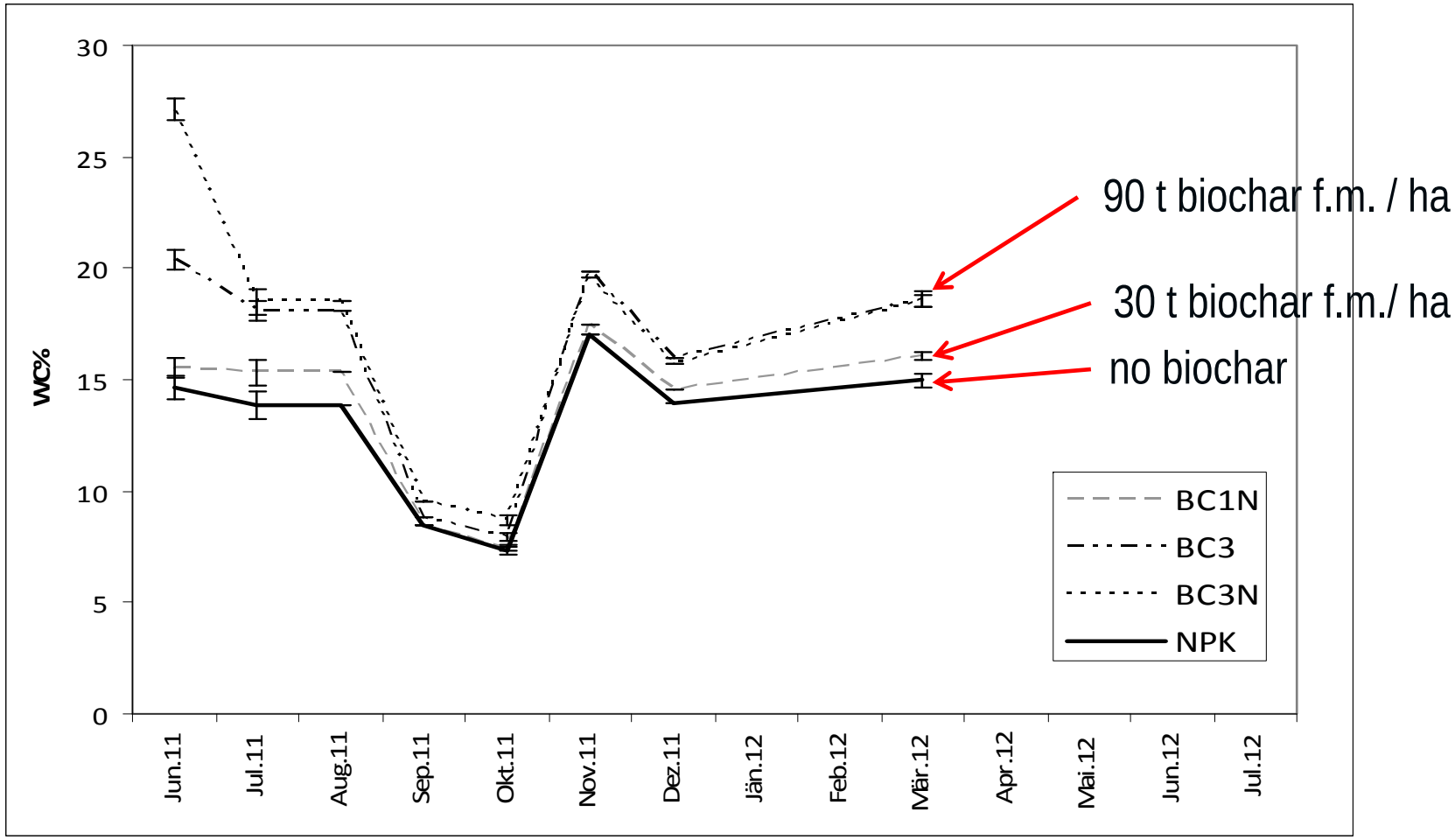
biochar = RomChar (wood-based charcoal)

Precipitation during the field experiments at the Traismauer site:
2011 Jan-Sep: 51 % of long-term mean (1971-2000)
2012 Jan-Sep: 93 % of long-term mean (1971-2000)

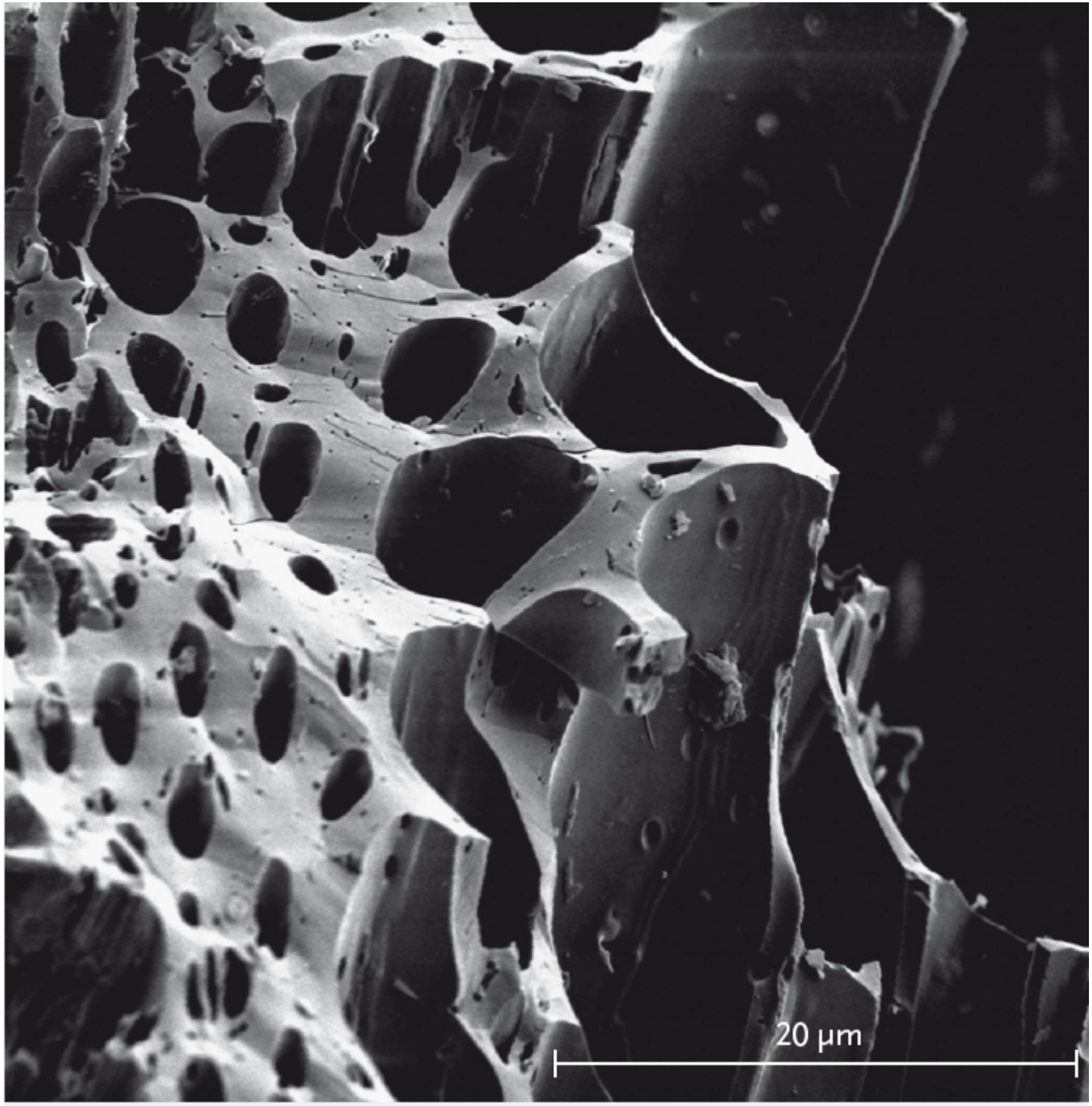
More water storage in plots with biochar in 2011?



Soil water content during the Traismauer field experiments



Soil water content was consistently higher in plots with biochar



Biochar in the electron microscope: the porous structure of plant material is conserved during pyrolysis

photo: Martin Brandstetter

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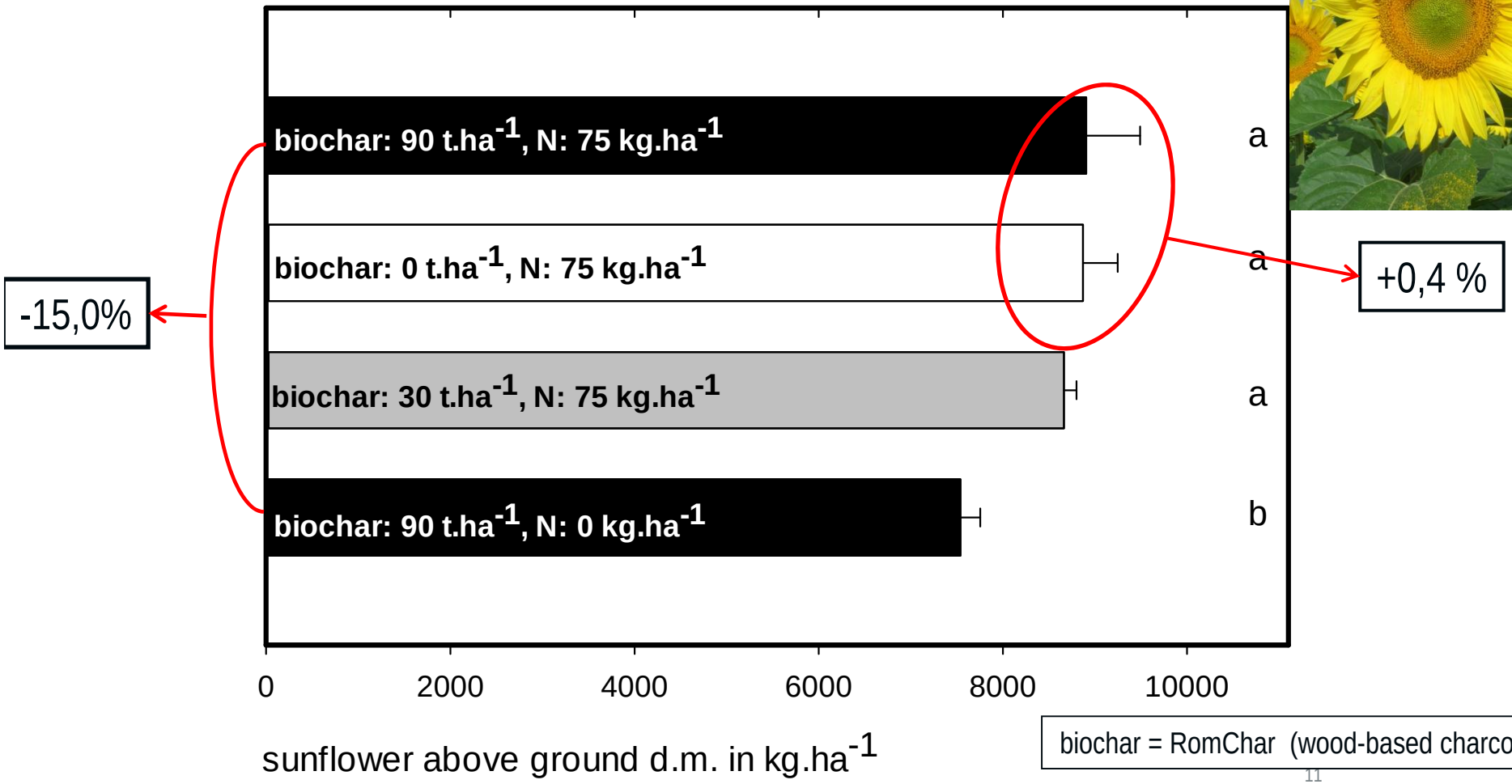
Field experiment Traismauer 2012: above ground d.m. of sunflower



biochar = RomChar (wood-based charcoal)

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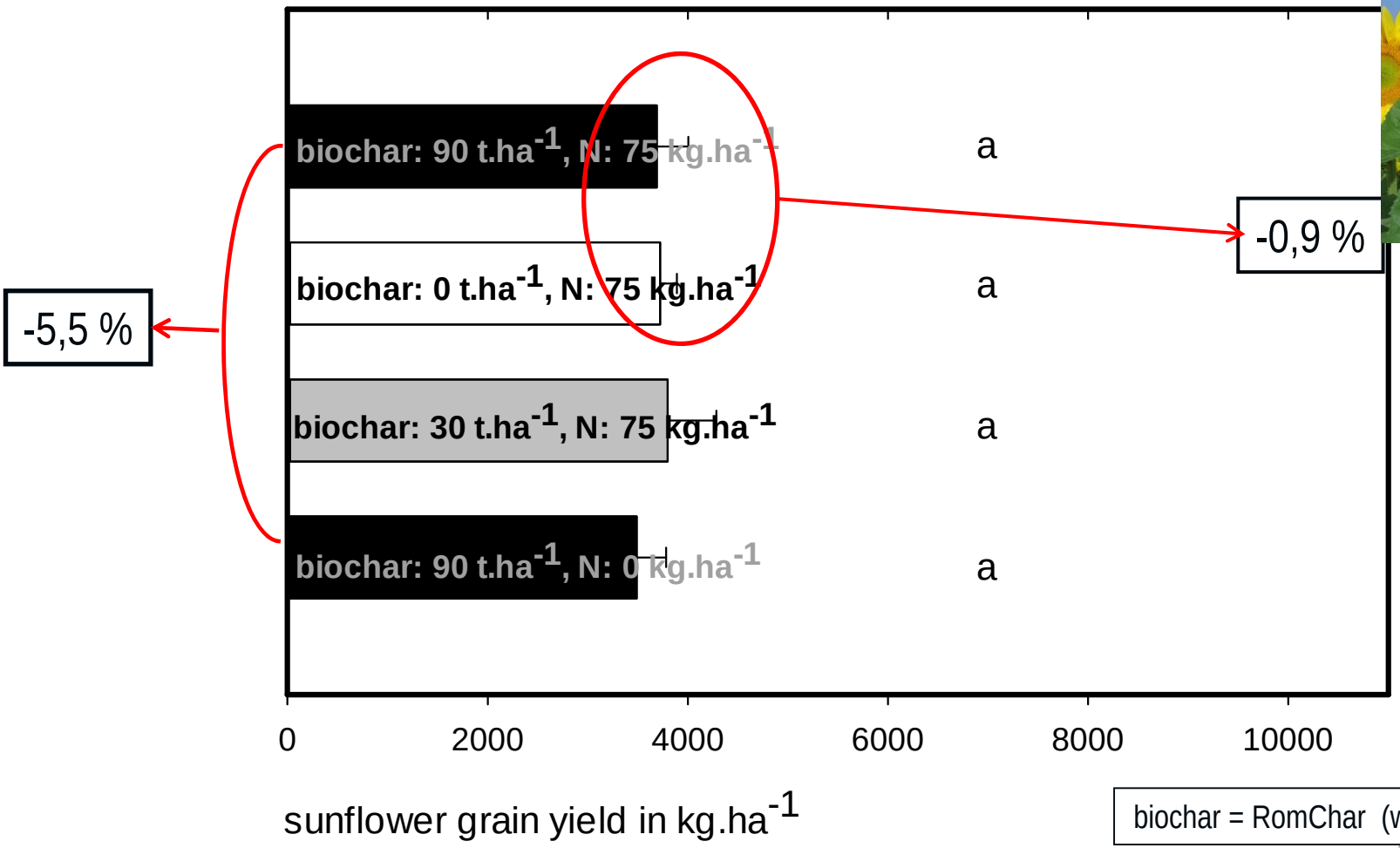
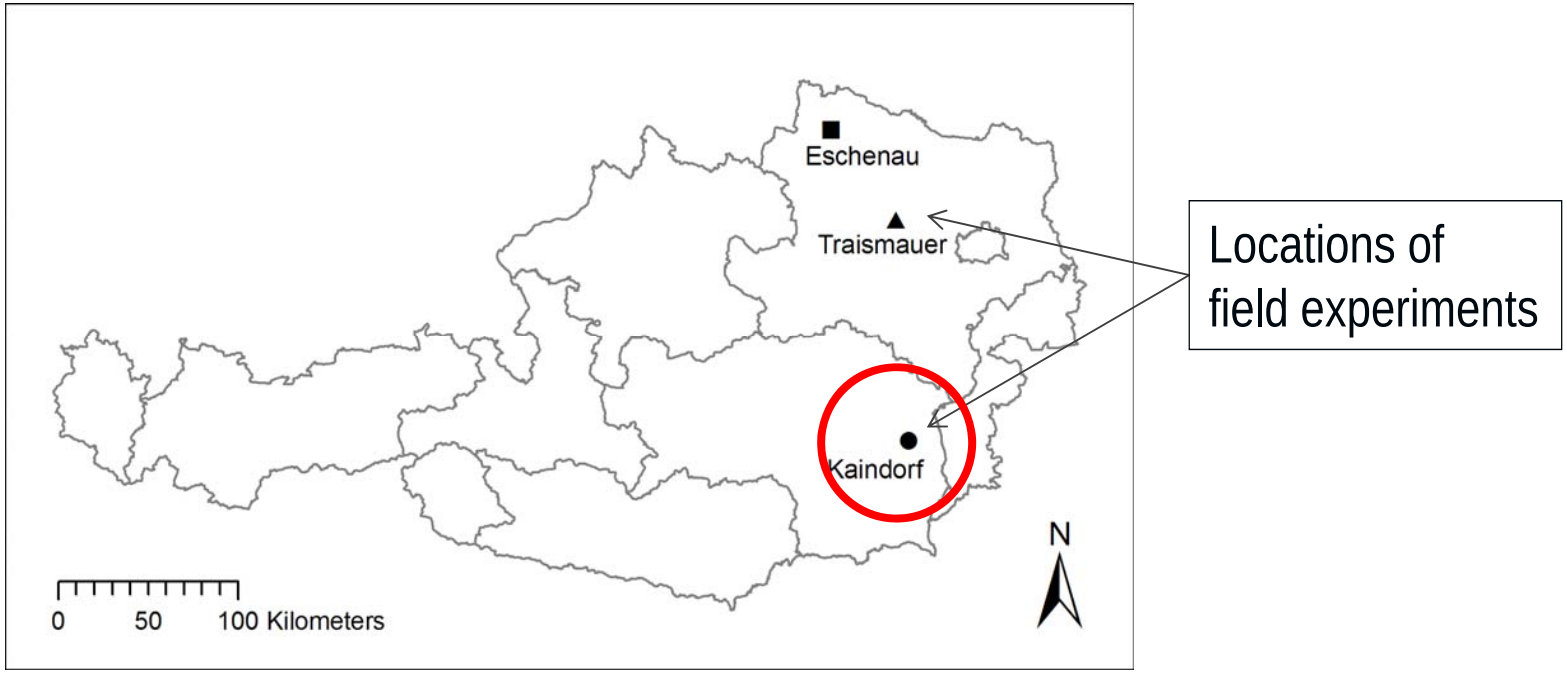
Field experiment Traismauer 2012: grain yield of sunflower

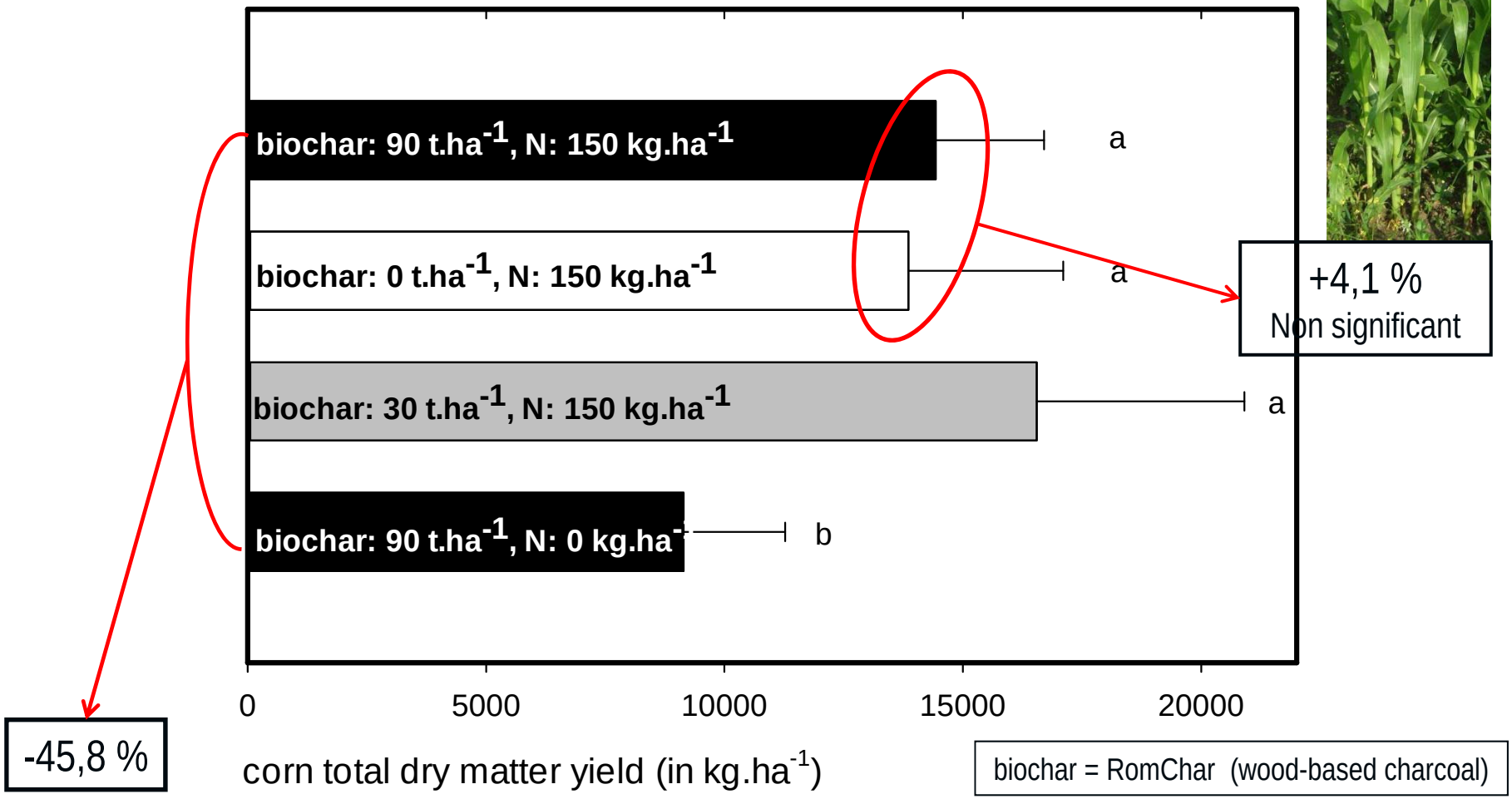


biochar = RomChar (wood-based charcoal)

Crop experiments with biochar in the field: Site **Kaindorf**

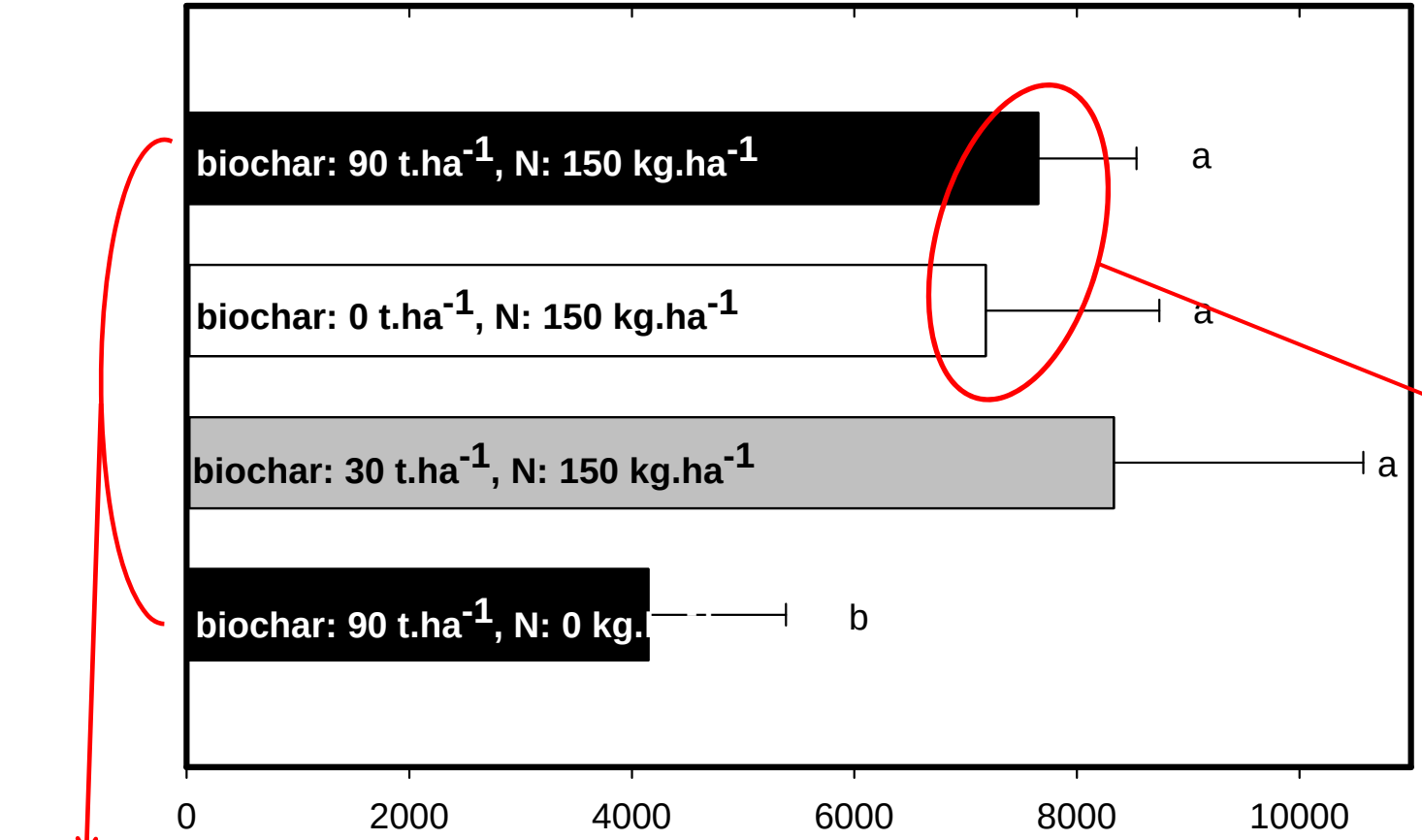


Field experiment Kaindorf maize 2011: above ground d.m.



biochar = RomChar (wood-based charcoal)

Field experiment Kaindorf maize 2011: grain yield



+6,6 %
non-significant

-45,8 % corn grain yield in kg.ha^{-1}

biochar = RomChar (wood-based charcoal)

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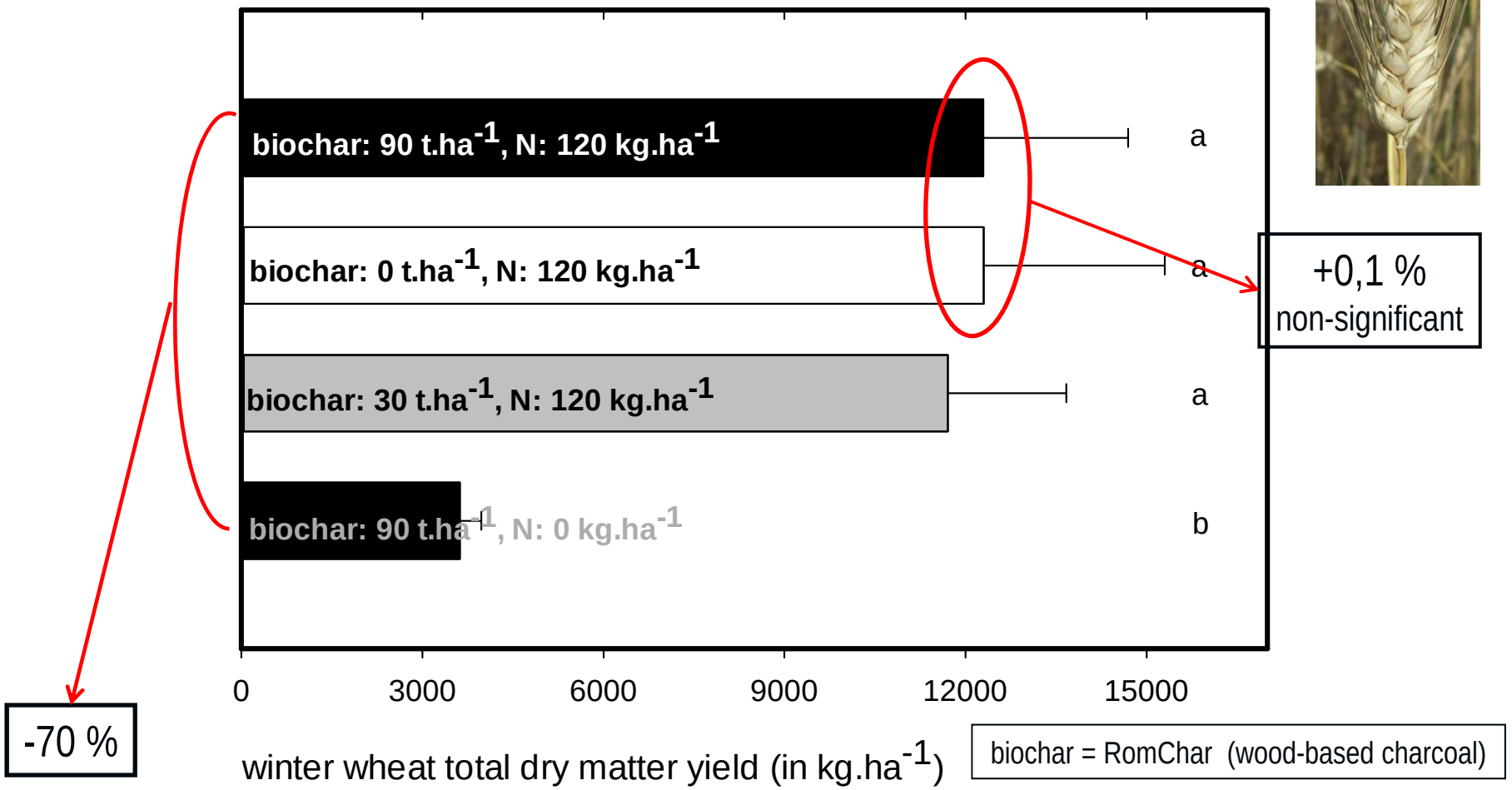
Field experiment Kaindorf winter wheat 2012: above ground d.m.



biochar = RomChar (wood-based charcoal)

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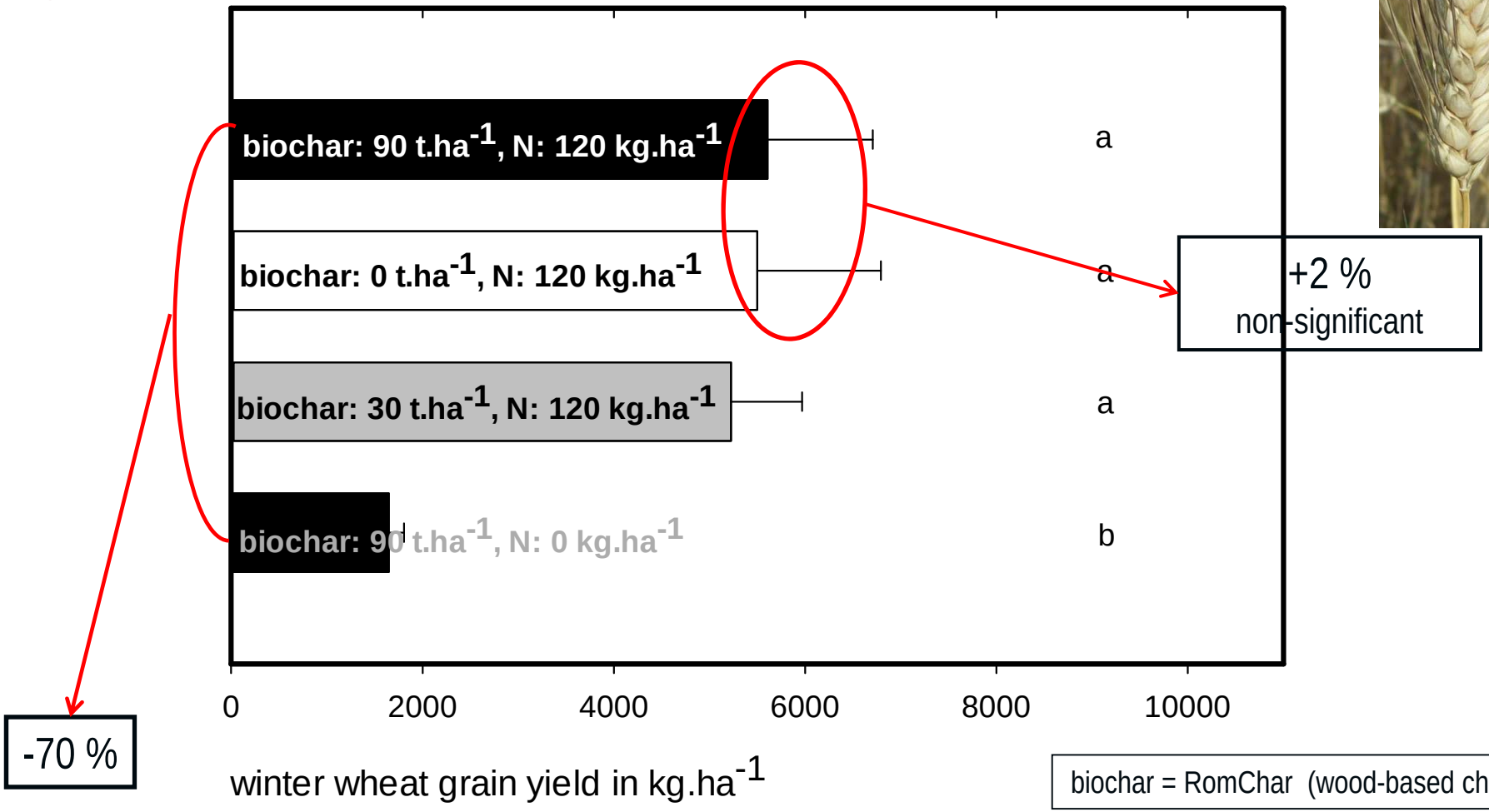
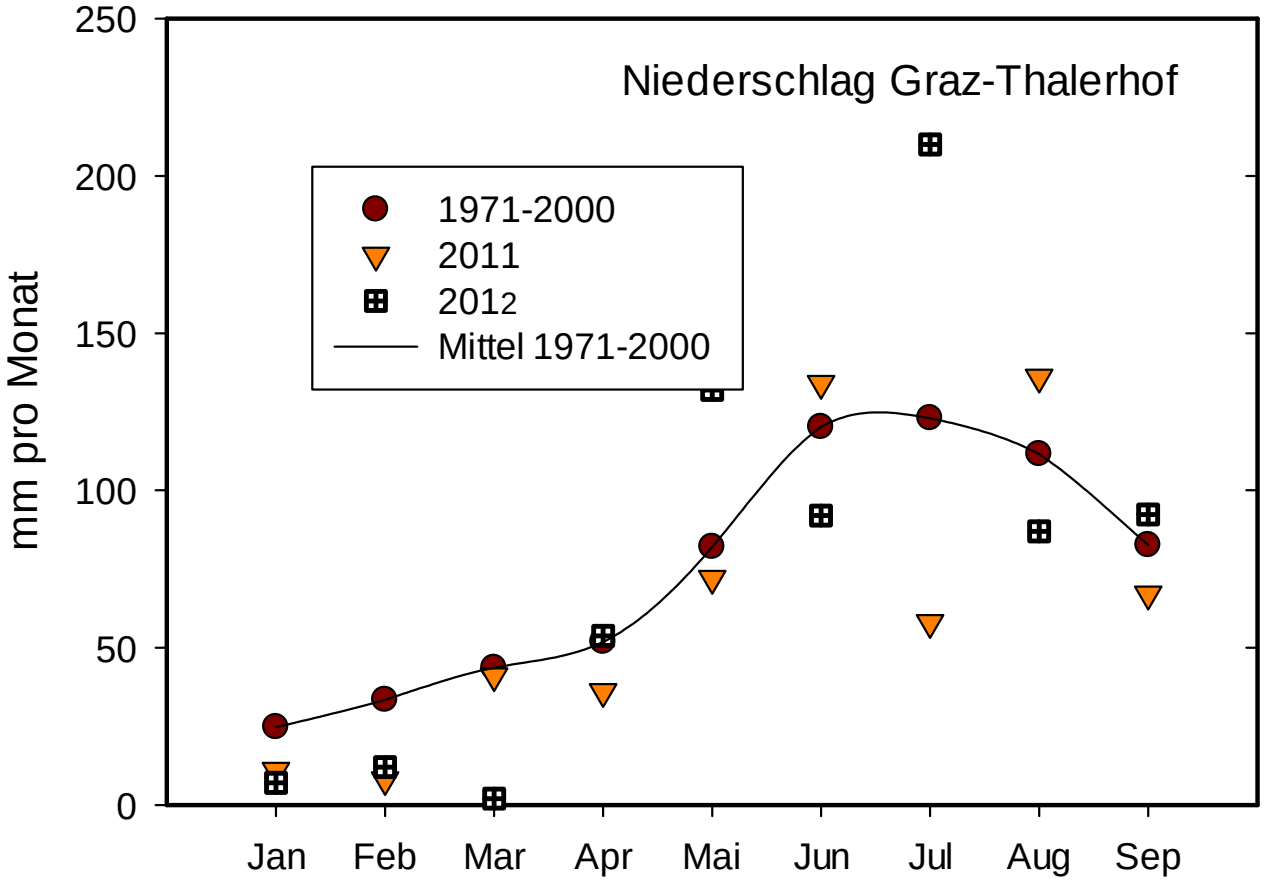
Field experiment Kaindorf winter wheat 2012: grain yield



biochar = RomChar (wood-based charcoal)

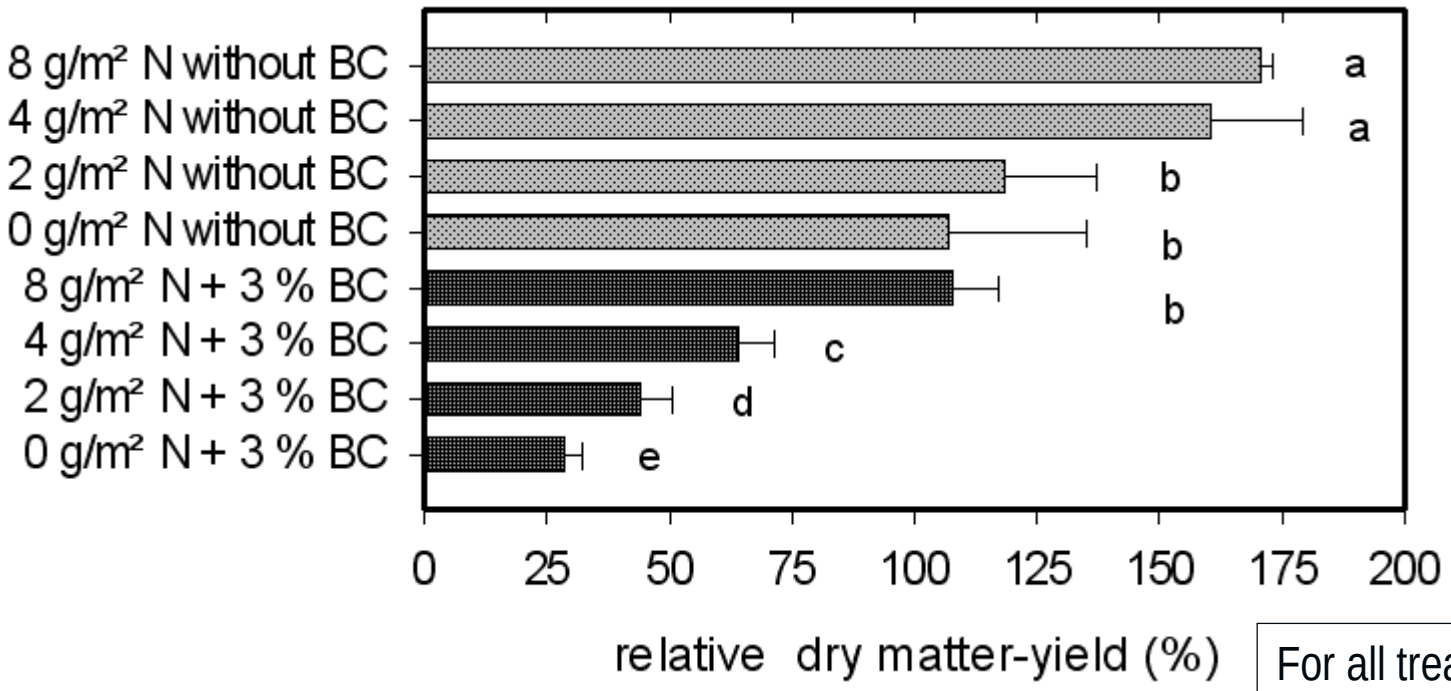
Precipitation during the field experiments Kaindorf:
2011 Jan-Sep: 84 % of long-term mean (1971-2000)
2012 Jan-Sep: 102 % of long-term mean (1971-2000)

No severe drought period in Kaindorf - improved water storage in biochar plots played no role



Crop biomass with different nitrogen supply levels: Nitrogen requirement of biochar in a sandy, acid soil in a pot experiment

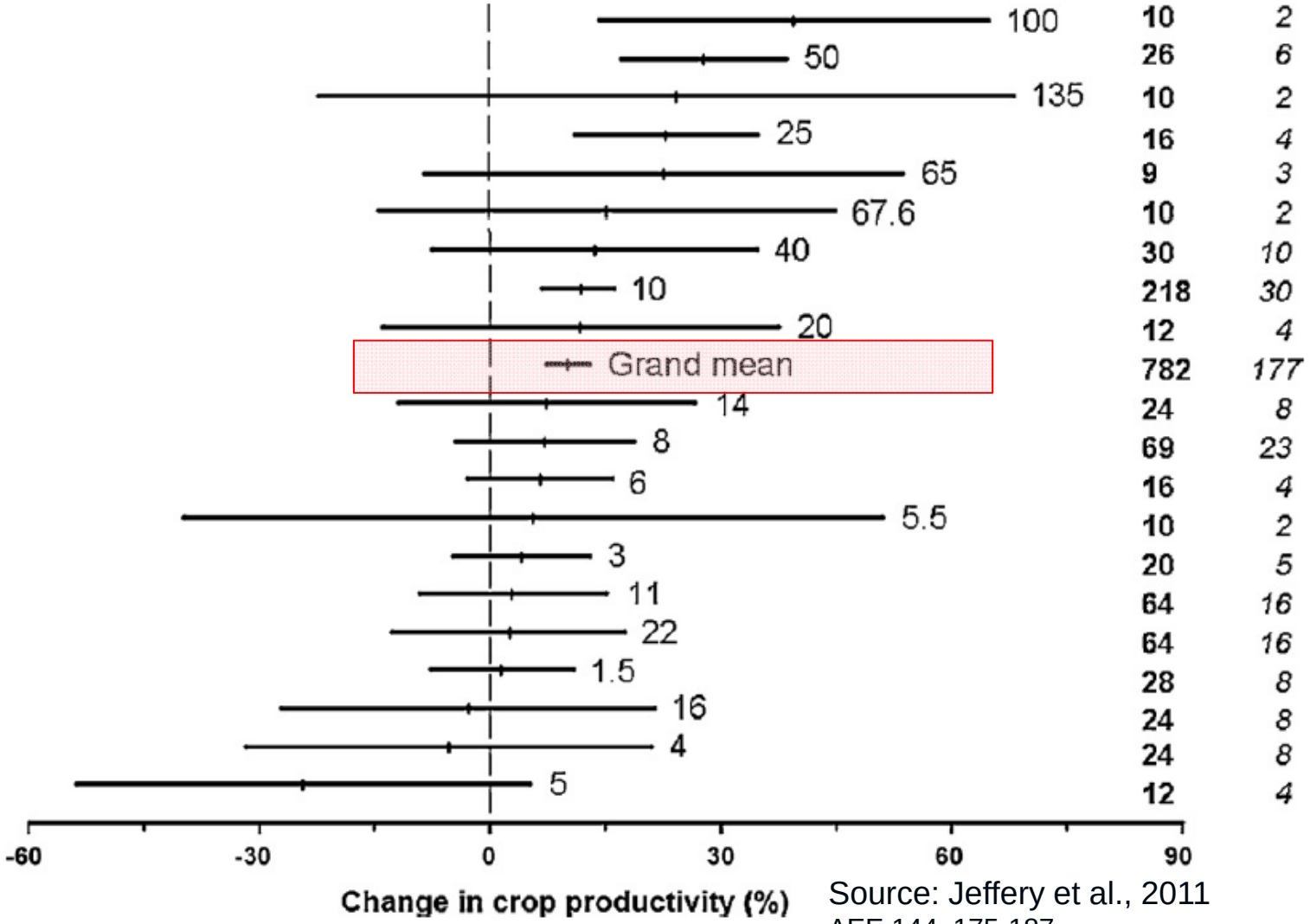
Competition of biochar, plant roots and soil microoganisms for nitrogen



100 % = 310 g/m²
Crop: Mustard

For all treatments:
- same biochar type
- same (sandy) soil

A meta-analysis of biochar effects on crop productivity (16 studies till 2010)



Source: Jeffery et al., 2011
AEE 144, 175-187

Biochar, the key to grow supercrops? Another literature overview (26 studies till 2012)

Parameter	Positive effects	No change	Negative effects
Crop yield	13	3	2
Thereof studies with HTC (hydro-thermal biochar)	0	1	1
Biomass	10	5	6
Thereof studies with HTC (hydro-thermal biochar)	1	0	4

Source: Germer, 2013 (UBA-Workshop, Berlin)

Conclusions:

Main considerations if you want to enhance crop productivity with biochar

Good chances for positive effects	Good chances for no (significant) change	Good chances for negative results
low soil pH (<5), Aluminium problematic	neutral soil (>6), no Aluminium problem	-
low C_{org} in soil	soils rich in SOM (humus-rich soils)	-
balanced N supply (organic or inorganic)	balanced N supply (organic or inorganic)	pure biochar without N-supplement
periodic drought periods, coarse texture	sufficient precipitation or irrigation, fine texture	-
compacted soils with low pore volume	well-textured soils	-
-	-	soil pesticide applications as part of the crop management strategy
Pollutant-contaminated soil	(depends on type of pollutant, DOC etc.)	-
Crops in soils that benefit from enhanced spring warming	-	-

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- Weinbauverband Traisental for experimental site I
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Thanks for your attention!

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