

Organic farming - low emissions, high sequestration, great adaptation potential?

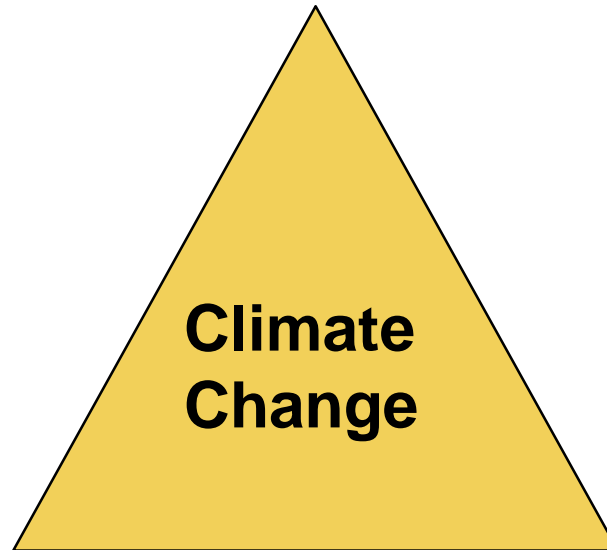
Climate change - organic strategies to meet a global challenge; Workshop, 15 February

Andreas Gattinger

The manifold role of agriculture regarding climate change



Climate polluter



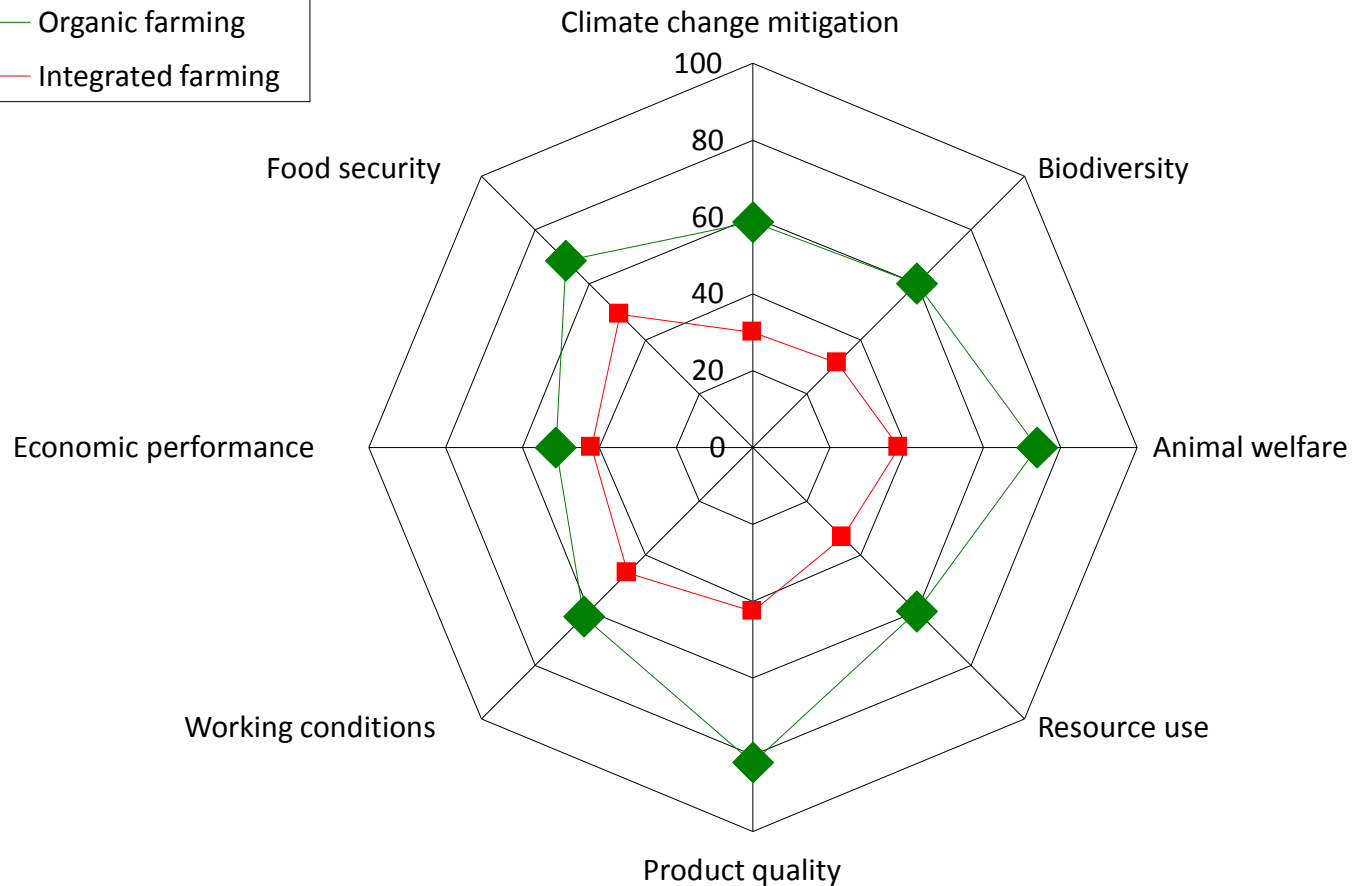
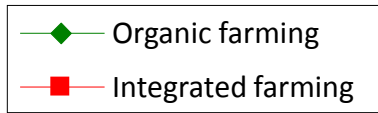
Climate Change

Affected

Climate protector



Organic farming systems – more than just climate-friendly



Source: Schader and Stolze (2010)



Contents

- Low greenhouse gas emissions in organic agriculture (OA)?
- High sequestration?
- Great adaptation potential in OA?

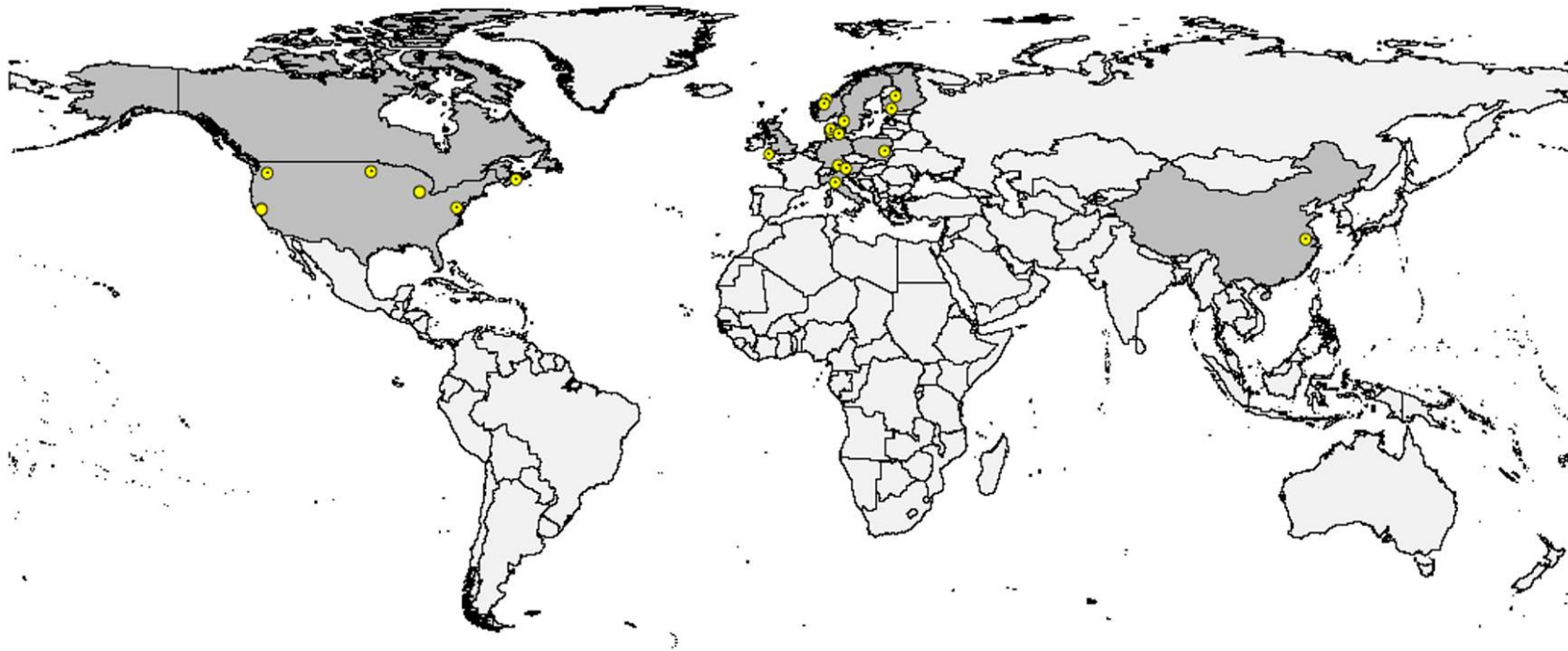


Contents

- **Low greenhouse gas emissions in organic agriculture (OA)?**
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GHG emissions from soils under organic and non-organic management



Skinner, Gattinger et al., STOTEN, submitted



Less N₂O from organically managed soils?

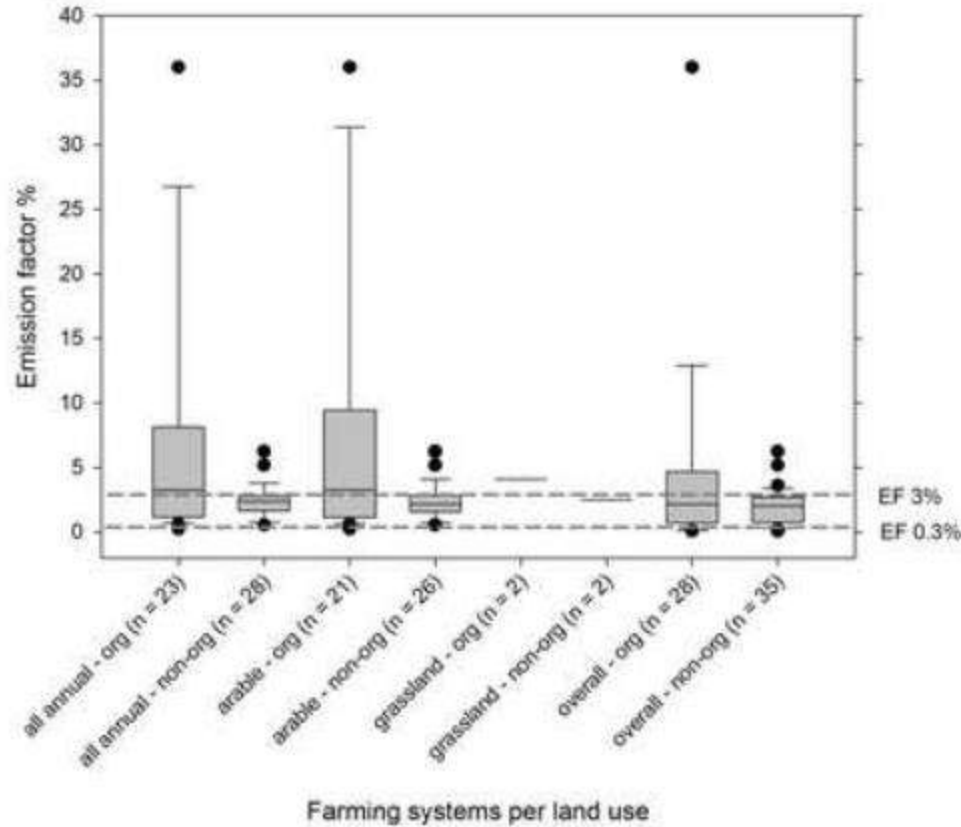
land-use	N ₂ O emissions per acreage (kg N ₂ O-N ha ⁻¹ a ⁻¹)					GWP ^d N ₂ O emissions per acreage (kg CO ₂ -eq. ha ⁻¹ a ⁻¹)				
	MD ^a	CI ^b	p	studies	comp. ^c	MD ^a	CI ^b	p	studies	comp. ^c
all (annual) ^f	-1.04	0.41	0.00	12	70	-486	191	0.00	12	70
arable	-1.01	0.42	0.00	11	67	-472	195	0.00	11	67
grassland	-2.42	5.16	0.36	2	3	-1133	2416	0.36	2	3
rice-paddies	-1.39	2.22	0.22	1	3	-650	1038	0.22	1	3
overall ^g	-1.03	0.32	0.00	18	98	-482	150	0.00	18	98

Yes, the mean difference is ca. 0.5 t ha⁻¹ yr⁻¹ less CO₂ eq. as nitrous oxide.

Skinner, Gattinger et al., STOTEN, submitted



Challenge in forecasting soil-derived N₂O emissions



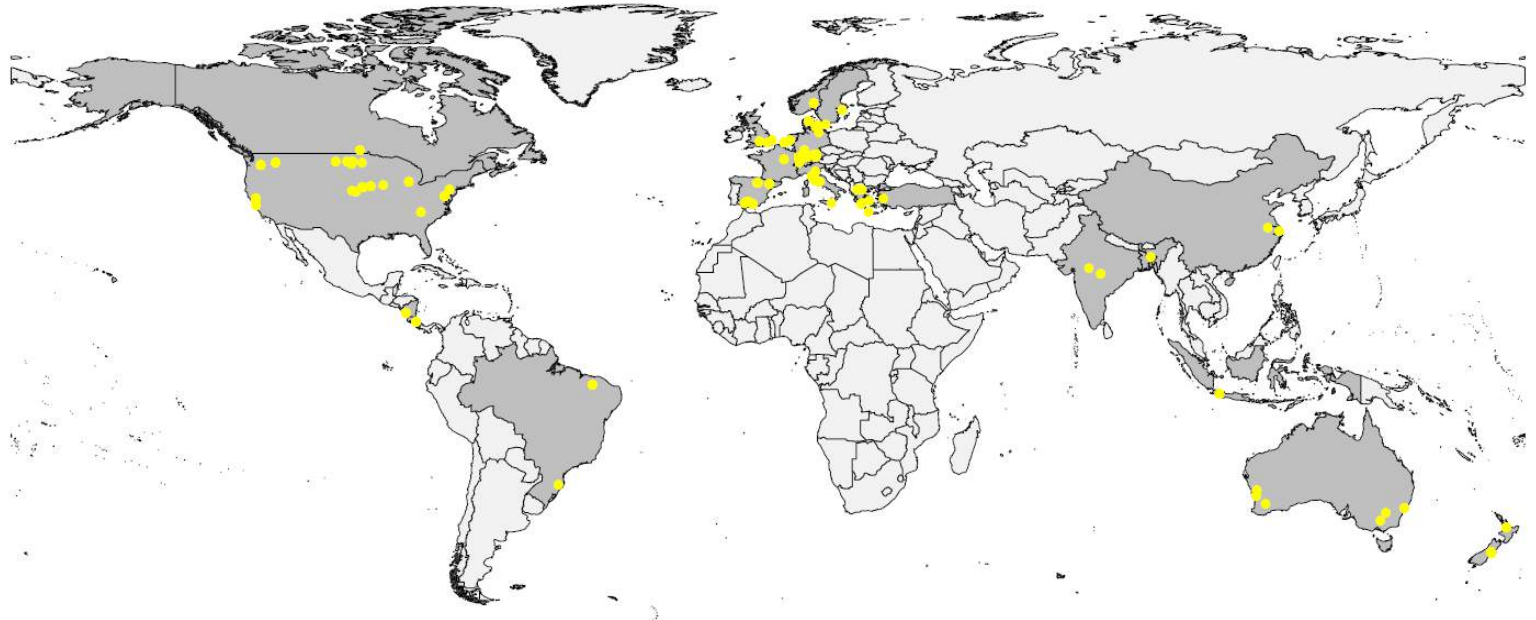
...high variation in EF for organic systems poses problems on LCA based approaches for sound climate balancing.

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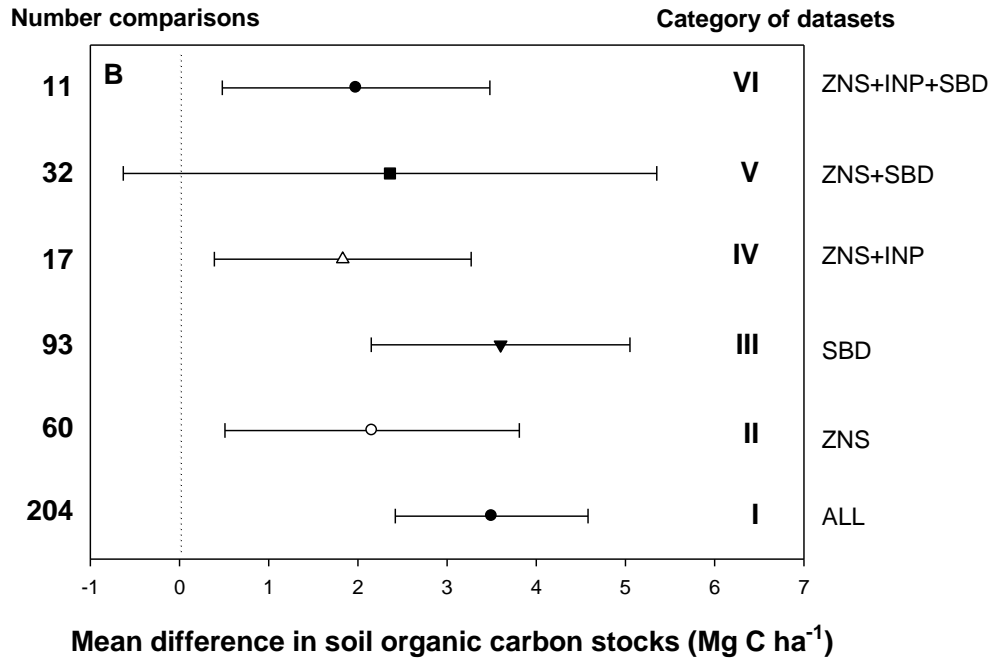
GHG mitigation through carbon storage in soils: organic vs. non organic



Gattinger et al., PNAS, 2012



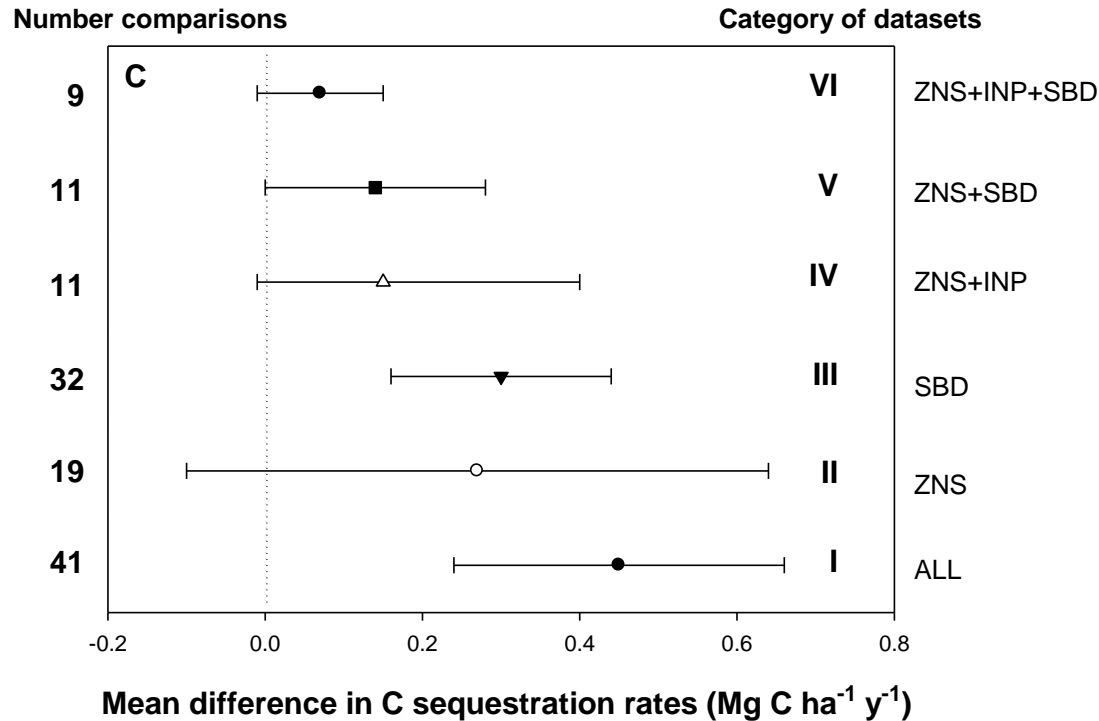
More carbon in organically managed soils?



Higher soil organic carbon concentrations (%) and stocks (t ha⁻¹) under organic farming management.

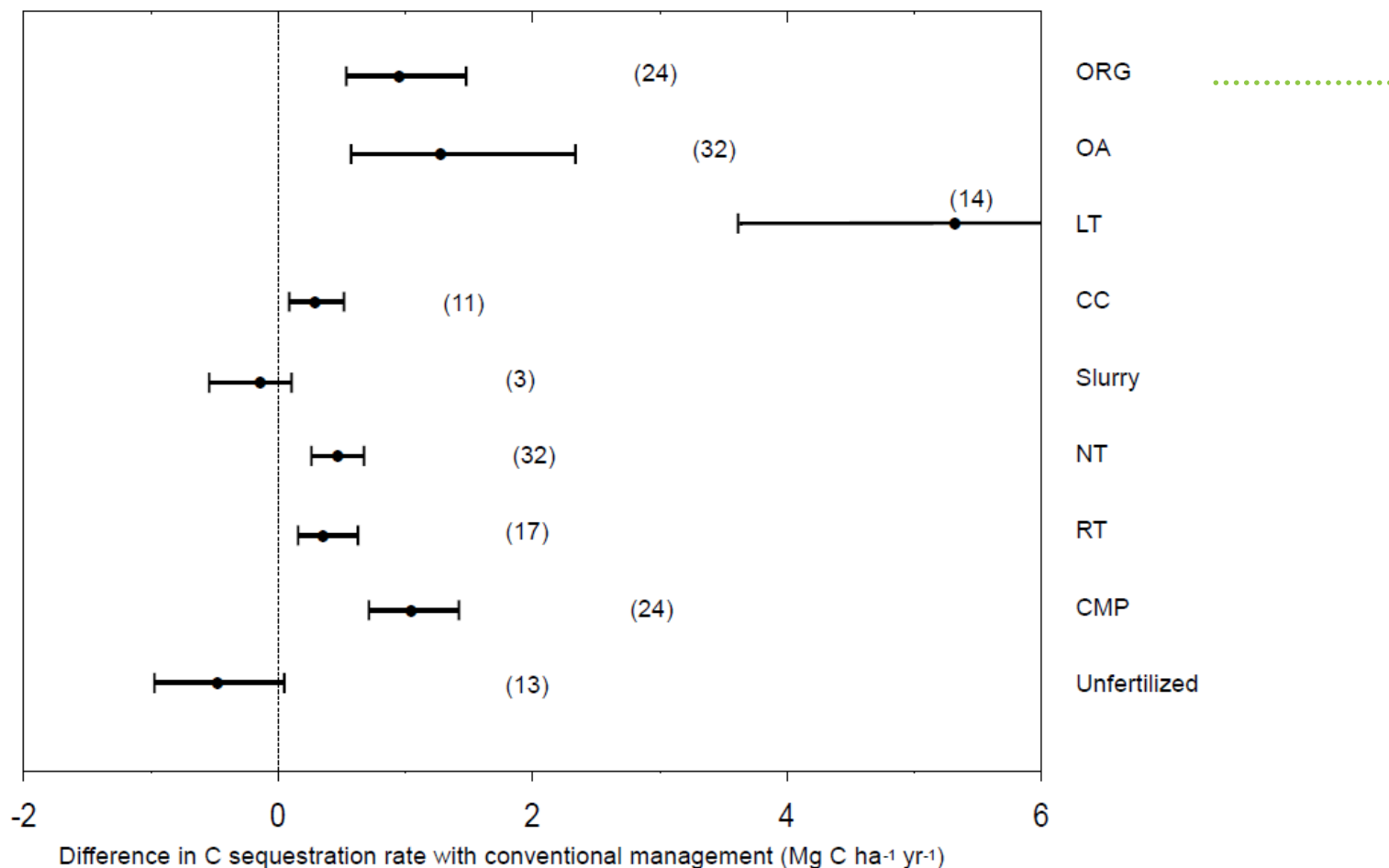
Gattinger et al., PNAS, 2012

Is C sequestration is possible within boundaries of organic farming systems?



Yes, it is possible. Net sequestration of 450 kg C ha⁻¹ y⁻¹ for all organic systems; the potential is lower for zero net input systems (< 1.0 ELU ha⁻¹): 70 – 270 kg C ha⁻¹ y⁻¹.

Pronounced C sequestration potential under ORG in Mediterranean soils



Aguilera et al., AGEE, 2013

Contents

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The consequences of higher soil organic matter are ...

- **Increased aggregate stability** (Gerhardt, 1997; Siegrist et al., 1998; Brown et al., 2000; Maeder *et al.*, 2002; Pulleman et al., 2003; Williams & Pettecrew, 2009).
- **Increased water holding capacity, higher water content in soil** (Brown et al., 2000; Lotter et al., 2003; Pimentel et al., 2005)
- **Improved infiltration rate of water** (Lotter et al., 2003; Pimentel et al., 2005; Zeiger & Fohrer, 2009).





Conventional/ IPM

Bio dynamic



Mäder et al. 2002, Science

Soil aggregate stability, infiltration rate

Fotos: Fliessbach Nov. 2002



IP with mineral fertilizers

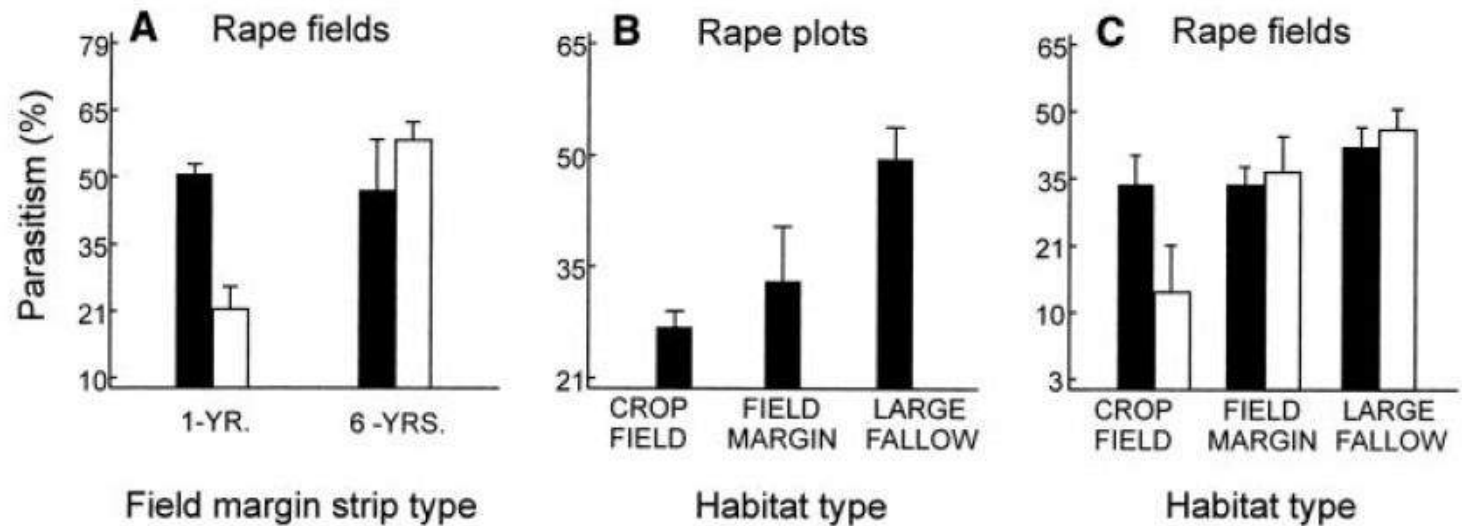
Biodynamic with composted manure



Eco-functional intensification as an approach to reduce vulnerability and improve resilience



Biological control of rape pollen beetle is influenced by landscape structure



(Thies & Tschardtke, Science, 2006)

Summary and conclusions

Organic Agriculture provides....

- Low GHG emissions? **Yes**
- High sequestration? **Yes**
- Great adaptation potential? **Yes**
- Organic farming is more than just climate-friendly agriculture. It provides further benefits to the society in a changing and resource-constrained world.

