The soil carbon dilemma in the humid tropics: cannot hoard it!?

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Rome, Italy

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CIAT's ongoing long-term trials in Western Kenya

Conservation Tillage ("CT1")

- since 2003
- test the impact of:
  1. **Tillage**: conventional tillage vs. zero-tillage
  2. Maize stover **residue** retention
  3. Maize mono-cropping vs. maize intercropped with soybean, and maize-soybean **rotation,** aliased with various levels of N and P **fertilizer** application

Integrated Soil Fertility Management ("INM3")

- since 2004
- test the impact of:
  1. Application of farm yard manure (**FYM**)
  2. Maize stover **residue** retention
  3. Maize mono-cropping vs. maize intercropped with soybean, and maize **rotation** with *Tephrosia candida*, aliased with various levels of N and P **fertilizer** application

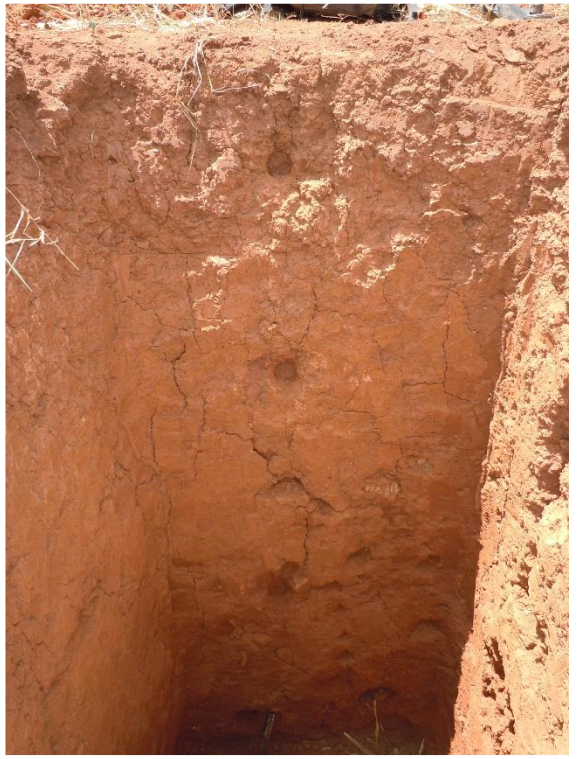
- **split-split-split plot design, 48 treatments, 4 reps, 192 plots**

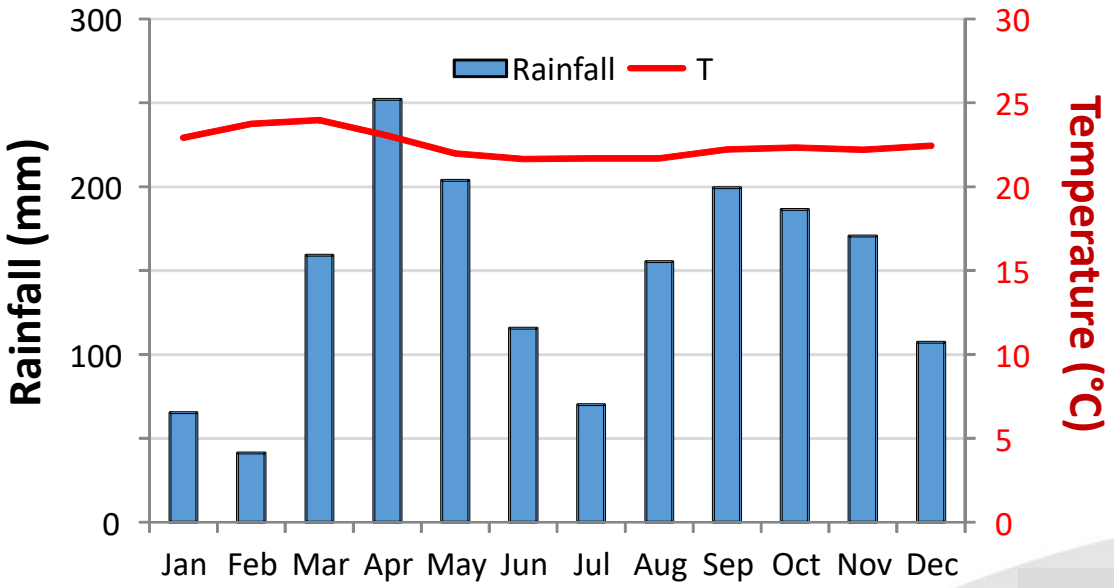
CIAT long-term trials – environment

- 1331 m above sea level
- Humid tropical climate
- Each year has a long- and a short-rainy season
- Average annual rainfall 1727 mm

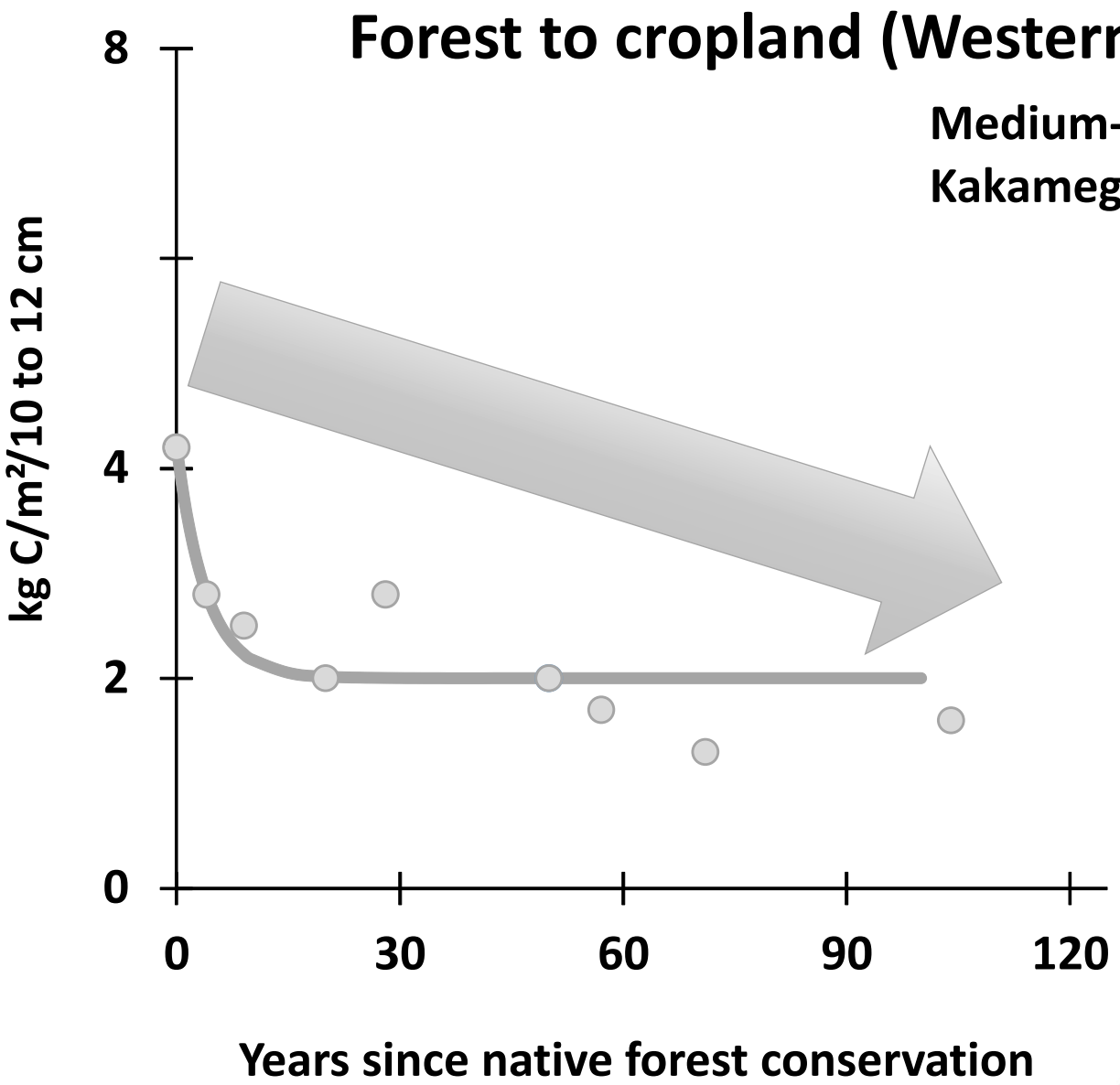
Acric Ferralsol

- >70 % clay
- low CEC
- pH 4.9-5.5
- P-fixing
- topsoil SOM 34 g/kg





Losses of SOC in response to Land use (change)



Source: Kinjangi, 2008 (PhD thesis, redrawn)

Observed SOC changes over time under "improved" land use

Contents lists available at ScienceDirect

Agriculture, Ecosystems and Environment

journal homepage: www.elsevier.com/locate/agee

Does conservation agriculture deliver climate change mitigation through soil carbon sequestration in tropical agro-ecosystems?

David S. Powlson[a,*], Clare M. Stirling[b], Christian Thierfelder[c], Rodger P. White[d], M.L. Jat[e]

In SSA increases were between 0.28 and 0.96 Mg C ha^{-1} yr^{-1}, but with much greater variation and a significant number of cases with no measurable increase. …

CA should be promoted on the basis of these factors and any climate change mitigation regarded as an additional benefit, not a major policy driver for its adoption.

Contents lists available at ScienceDirect

Soil & Tillage Research

journal homepage: www.elsevier.com/locate/still

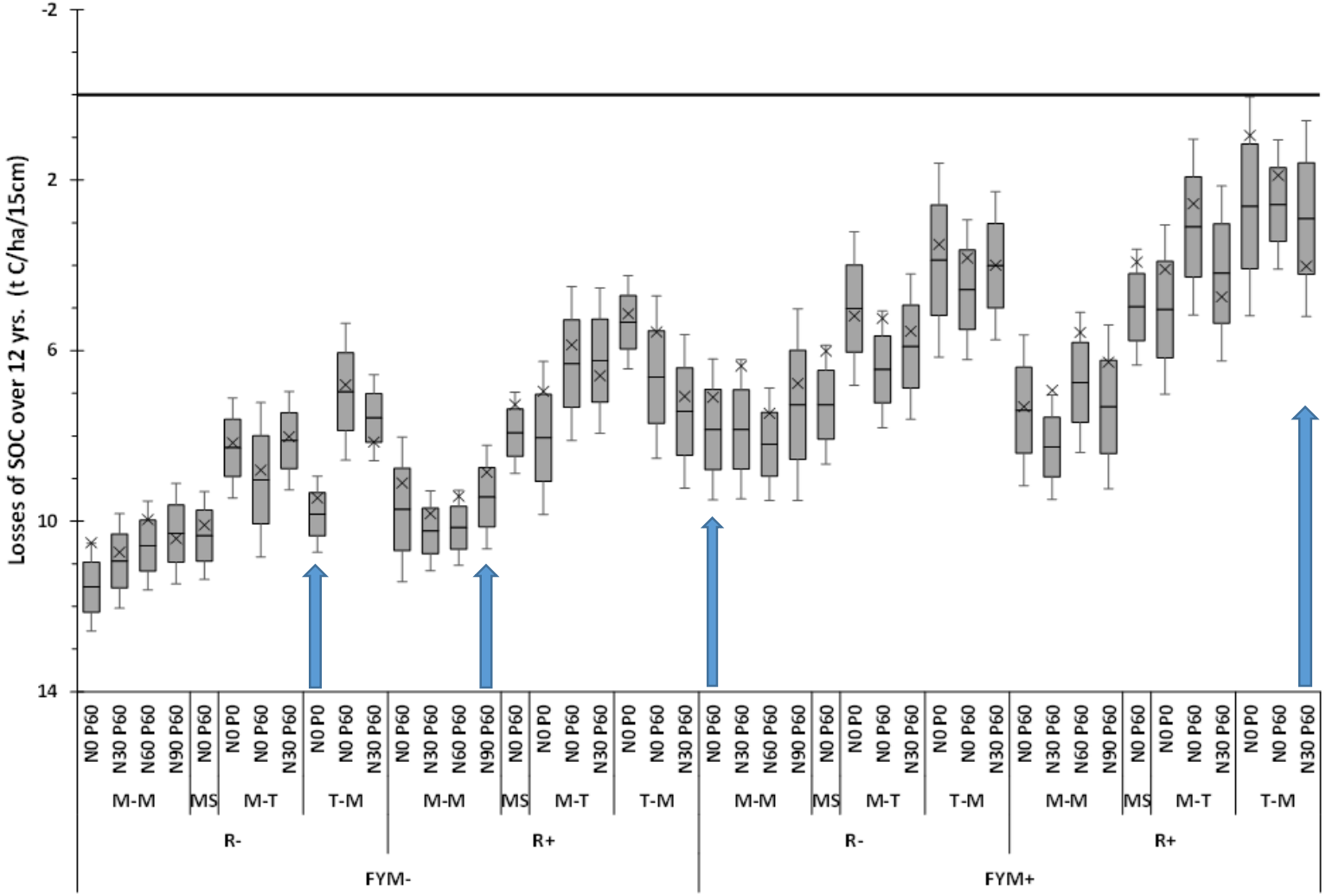
Soil carbon stocks in conservation agriculture systems of Southern Africa

Stephanie Cheesman[a,d,*], Christian Thierfelder[a], Neal S. Eash[b], Girma Tesfahun Kassie[c], Emmanuel Frossard[d]

… data from 125 on-farm validation trials across 23 sites in Malawi, Mozambique, Zambia and Zimbabwe. … No consistent differences in bulk density and soil C concentrations were found. … These results … indicate that there is a limited potential for conservation agriculture to significantly increase soil C stocks after up to 7 years of conservation agriculture

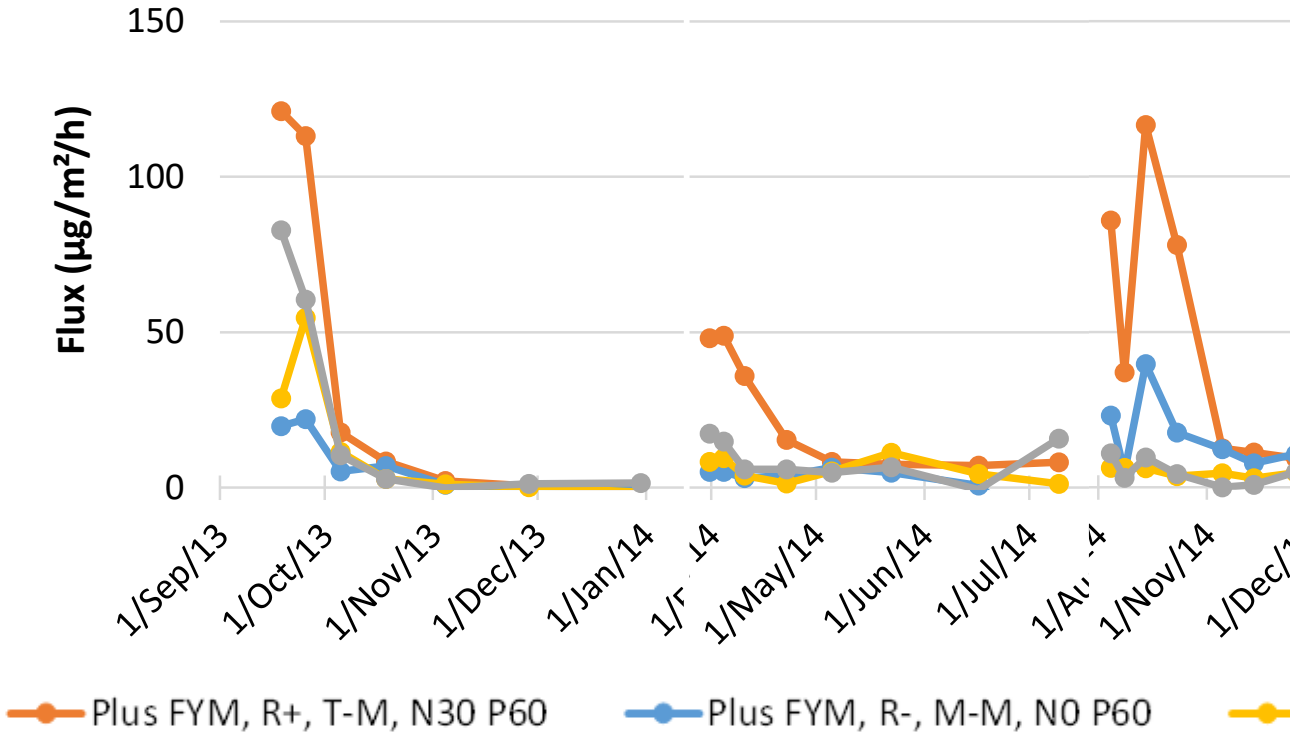
SOC decreases everywhere: lower losses under high organic matter input systems

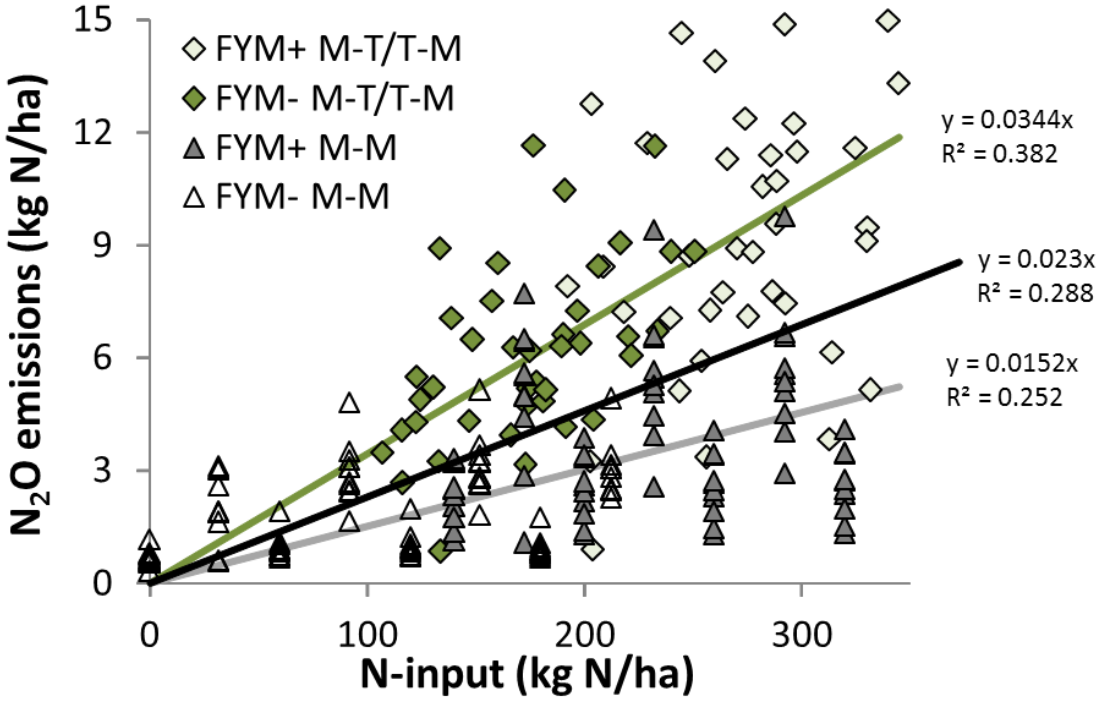
initial SOC content of ~24.2 g/kg.



N_2O emissions in selected treatments

- Increasing organic matter inputs means increasing nitrous oxide emissions

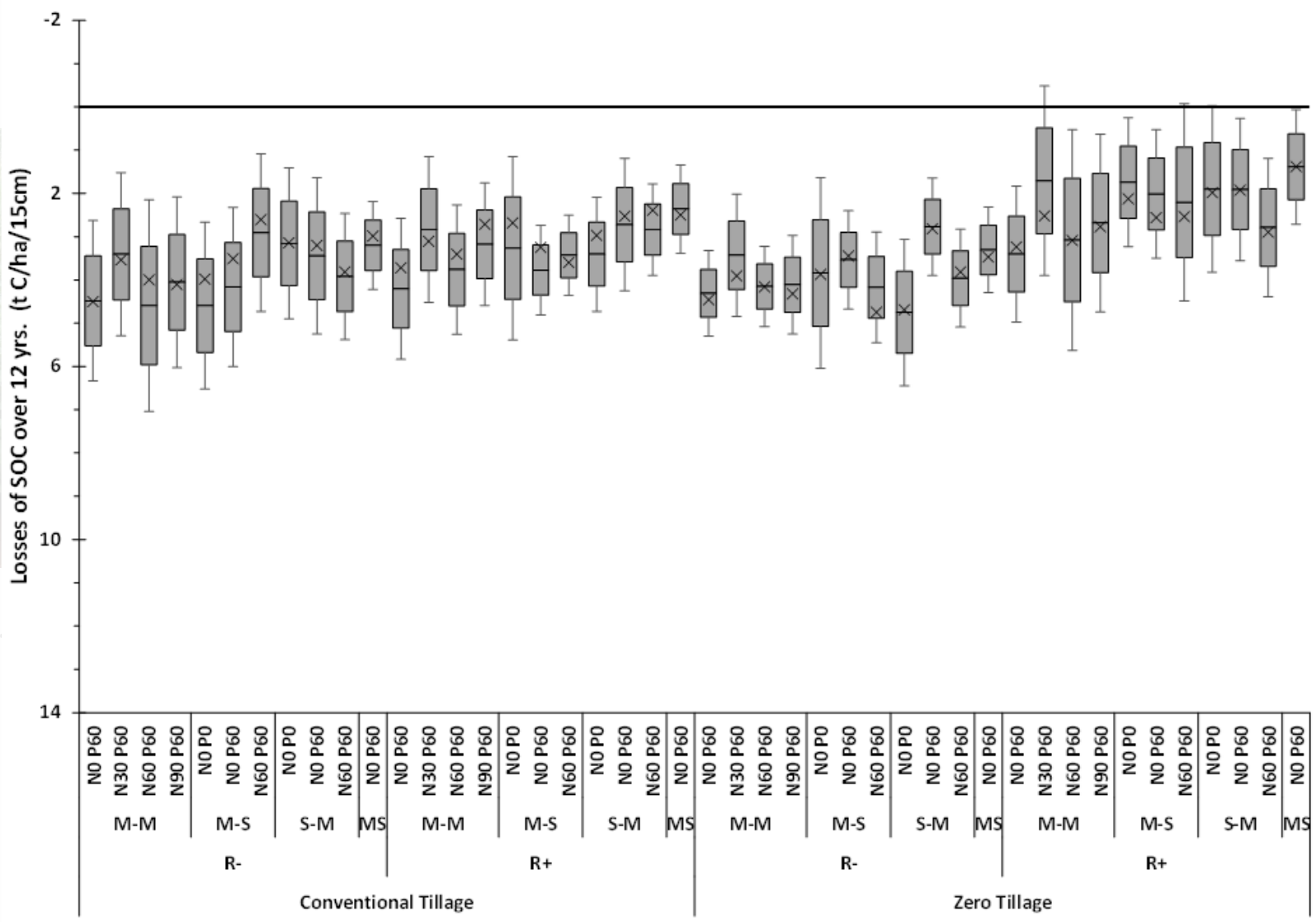




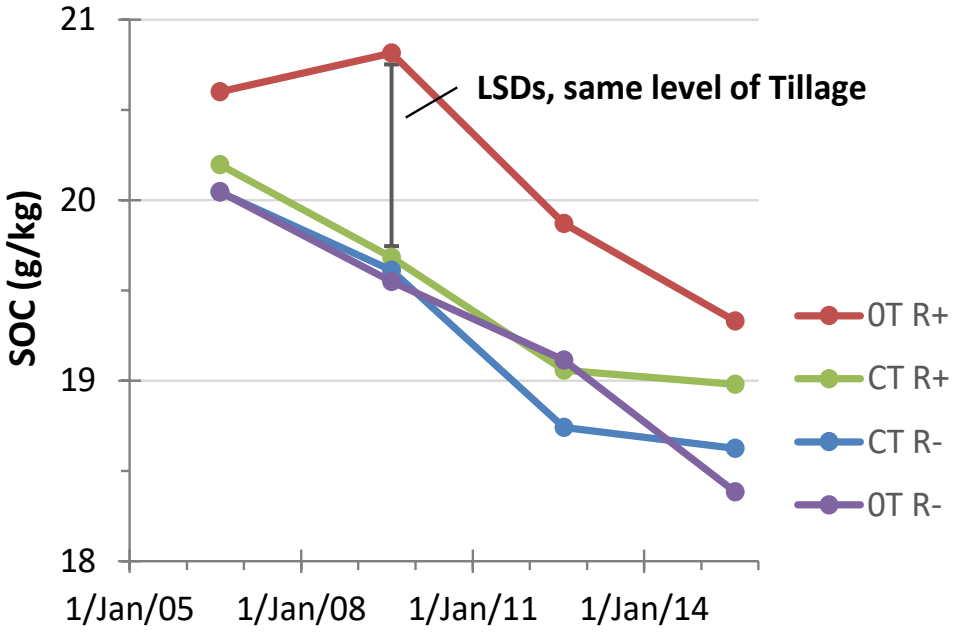
see also Sommer et al. 2015 in Nutrient Cycling in Agroecosystems (link)

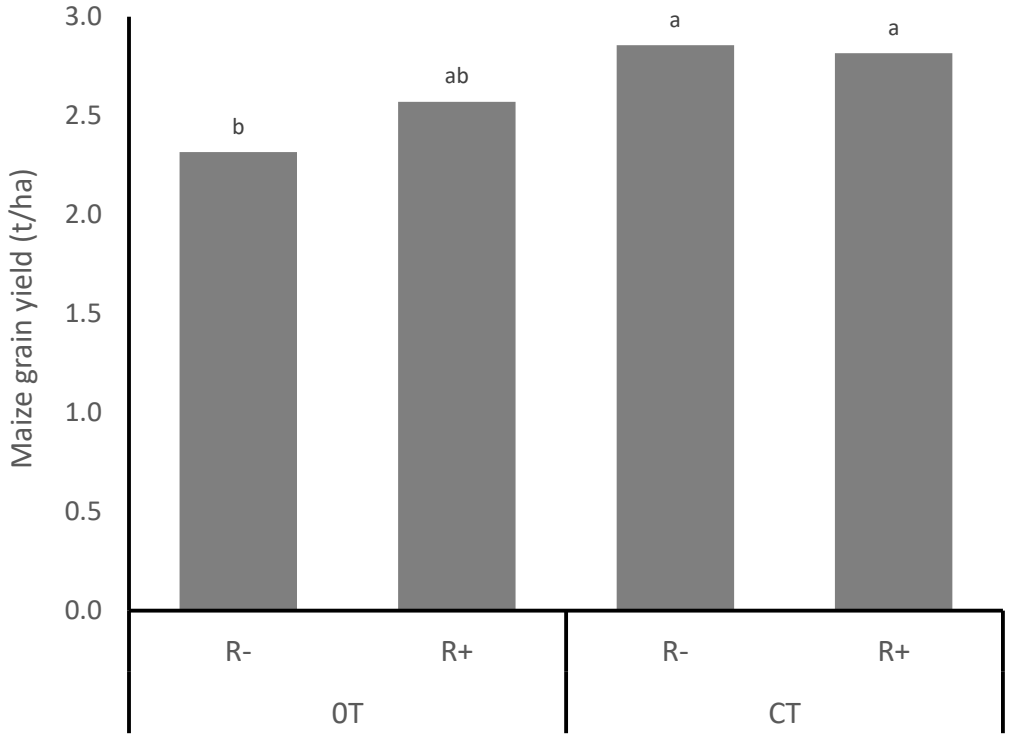
SOC decreases everywhere: lower losses conservation agriculture

initial SOC content of ~20.8 g/kg

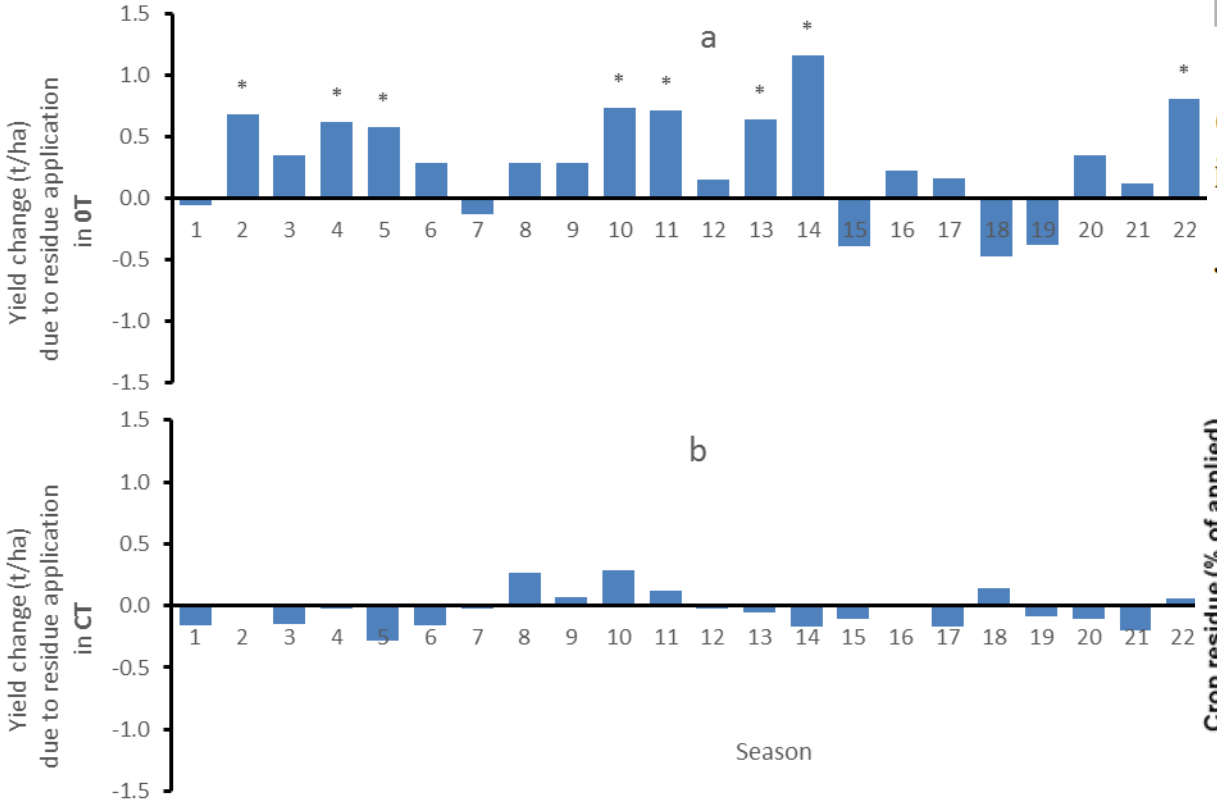


Influences of tillage and residue management on SOC and Yield





Trends of yield change due to residue application

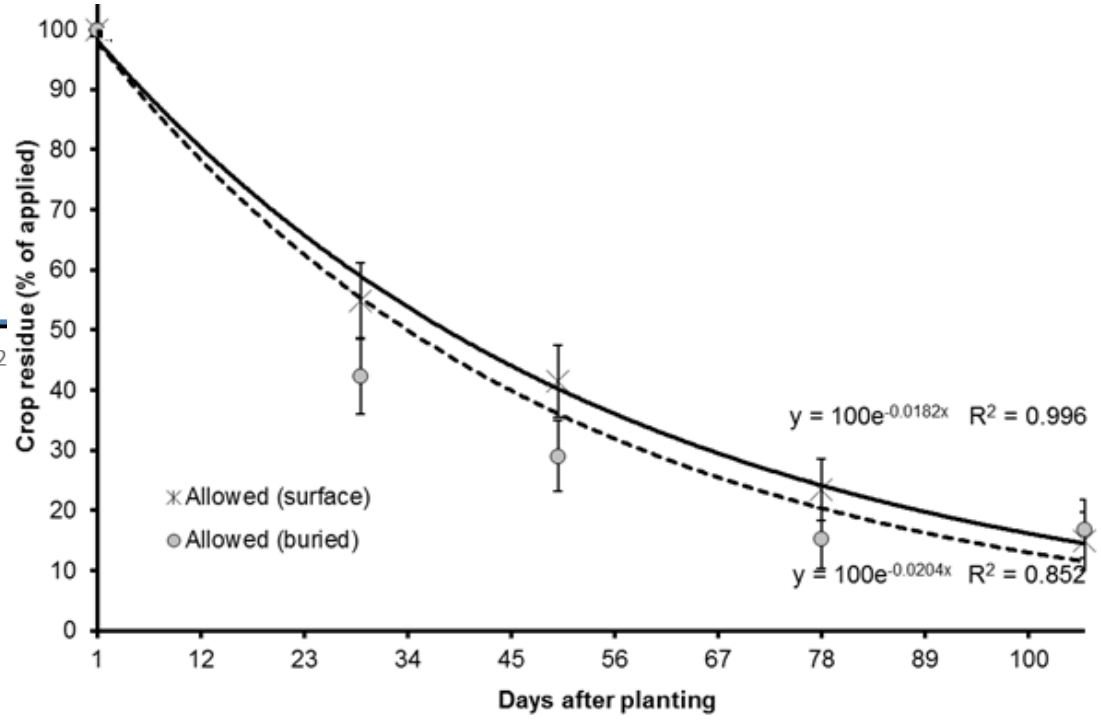


Nutr Cycl Agroecosyst (2015) 102:101–111
DOI 10.1007/s10705-014-9649-2

ORIGINAL ARTICLE

Crop residue disappearance and macrofauna activity in sub-humid western Kenya

J. Kihara · C. Martius · A. Bationo



Aggregation and GHG fluxes

	Potential denitrification	Aggregate MWD (mm)	CO2 FLUX ($mg/m^2/h$)	N2O FLUX ($\mu g/m^2/h$)
0T+R+Rot+60N	5.35	1.52a	9.48	20.66
0T+R+Int+0N	6.47	1.62a	11.39	17.39
CT-R+Rot+60N	2.06	1.03b	8.21	16.78
		**		

Reversing SOC declines

- Revisit the individual "best bet" cases (above all grasslands)
- In sub-Saharan Africa food security and sustaining soil fertility comes first, SOC sequestration is a co-benefit only!
- Very different type of cropping systems are required for "carbon" sequestration also for mixed crop-livestock farmers
- Eliminate bare ground in the seasonal loop!

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